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and The AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

MARCH 25th, 1943

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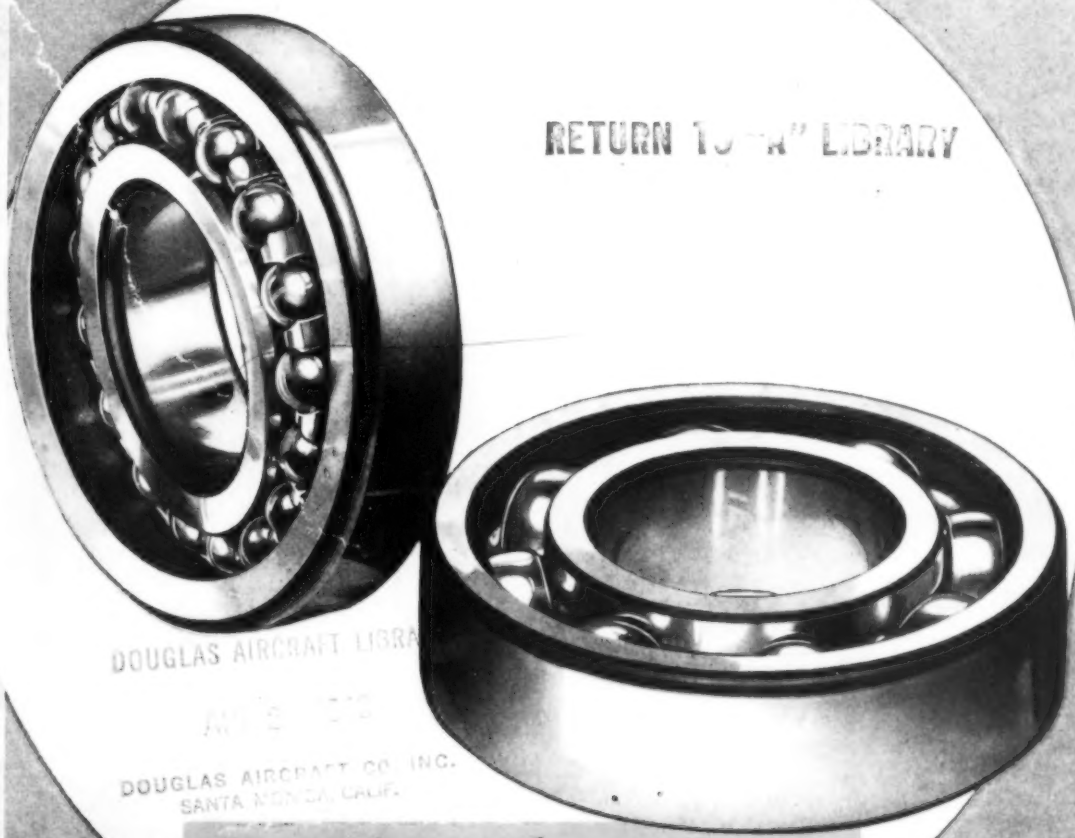

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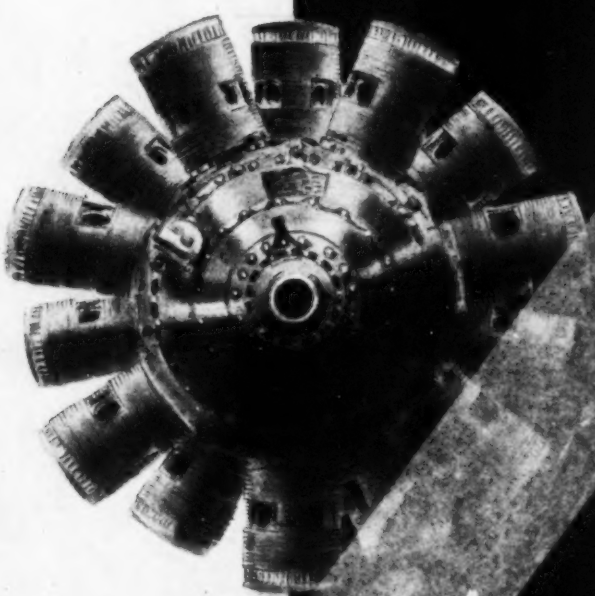

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HERCULES

TWO-ROW RADIAL SLEEVE-VALVE ENGINE

FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

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The Outlook

Post-war Civil Types

SEVERAL weeks ago we referred to the need for starting work at once on the design of the commercial aircraft types which are to carry the bulk of our air traffic on the long-distance routes after the inevitable interim period is over, a period during which we shall have to make do with converted bombers and with such commercial types as we can obtain from America.

The Air Minister's statement in his Air Estimates speech that the War Cabinet has decided

> "that the design of a limited number of types of civil aircraft shall proceed with the assistance of the Government as and when it can be arranged without interfering with work on aircraft required for the war."

is to be welcomed; but one could have wished that Sir Archibald Sinclair had omitted the qualifying proviso "as and when," etc.

Everything will depend upon the Government's interpretation of that proviso. We do think that the Air Minister might have inserted after "interfering" the word "seriously." That design work of this nature must interfere to some extent is inevitable. Even if the task is allocated to one or two firms which could spare the necessary design staff at the moment, it might be argued that if that is so, the men ought, in the national interest, to be transferred to firms which are badly in need of additions to their technical staffs.

There is another danger in this equivocal and somewhat grudging agreement by the Government to let a start be made on post-war designs. If the Air Minister's statement means what it implies, viz., that starting on the new designs is subject to the work not interfering with war production, it would appear to follow as a logical corollary that the task might be entrusted to a firm or firms with little or no previous experience of commercial aircraft. The very fact that its design staff was not very busy would indicate that it had not been very successful with military types, and it is therefore scarcely to be expected that it would turn out anything very brilliant in the commercial line.

We should feel a great deal happier if the Air Ministry would announce the names of the firms chosen to design the post-war commercial types on which so much will depend in the future. The task of foreseeing what will be wanted, and of incorporating in the design everything which the latest knowledge can suggest, is a formidable one and certainly not one to be undertaken on any "as and when" basis.

Helicopters

WITH this week's issue we begin a series of articles on rotating-wing aircraft. From the earliest days *Flight* has given prominence to this subject whenever opportunity occurred. When Señor Juan de la Cierva brought his C6 to this country in 1925 many of those who witnessed Frank Courtney's demonstration scoffed at the idea of such a "whirligig" ever being of any practical use. We had followed Cierva's work in his native Spain from the beginning, and we knew that here was no hare-brained inventor with an idea but no real knowledge, such as have cropped up all through the history of flying, but a man who had studied his problems seriously, and who had accumulated sufficient experience to be sure of his ground and of ultimate success.

During the ensuing years, when Cierva established himself in this country and, backed by private finance, carried on doggedly with the difficult task of developing and perfecting his ingenious machine, we recorded in our

pages each step forward. Even when setbacks brought things almost to a standstill, as did occur now and again, we did not lose faith. At the time of his lamentable death in a passenger aircraft Cierva had gone a very long way towards his ultimate goal, the helicopter. His jump-start Autogiro left the ground with no forward run, and the touch-down "on a spot" had been a feature of his machine from the earliest days.

With Government support the step forward to the real helicopter would not have been a very difficult one. That same private enterprise which had made Cierva's work possible continued to the best of its ability, but then came the war, and after a time the department was closed down in order to release personnel for war work.

Both technically and financially the nation owes a great deal to Juan de la Cierva and those who believed in him, and who, even more important, backed their belief with hard cash. It might have been thought that when the Government decided to order helicopters it would have gone to the British firm which has already done such a vast amount of pioneer work.

Looking Ahead

THERE are possible grounds for speculation in one passage of the Prime Minister's broadcast on Sunday last. Did he, or did he not, mean anything in particular by the way in which he arranged his list of activities for this country after the war? In a passage near the end of the broadcast he spoke of various ways in which unemployment might be avoided, and, after mentioning gas and electricity, he went on: "There is civil aviation. There is forestry. There is transportation in all its forms. . . ."

To most people the term "civil aviation" means either private and club flying, which are mainly forms of recreation, or serious, businesslike air transport. Railway Air Services, Ltd., is a pre-war concern, now almost ancient history; of late shipping companies have been considering seriously the parallel working of transport by sea and by air. To those great and experienced transport interests the air is but one more form of transport which they are progressively coming to regard as an ally instead of as an upstart rival. Yet in the mind of the Prime Minister the two ideas did not fall together. They were separated by the thought of forestry.

Mr. Churchill is no ignoramus on the subject of flying. From the earliest days he has been profoundly interested in it, and of late he has travelled by air very many thousands of miles. The sequence of his sentences suggested that in his mind surface transport and air transport are two separate things.

This sequence of sentences may have been a mere chance. Mr. Churchill may have been thinking aloud, but there is no orator to-day who is more careful in the arranging of what he says. Can it be that the Prime Minister has in his mind a separate Ministry of Civil Aviation which will be commissioned in the years after the war to develop air transport on its own lines and press ahead with it faster and farther than the established interests of rail and steamship transport would be likely to do? That is at least a possibility. Up to a certain point the utilisation of aircraft by the established and experienced organisations of surface transport may confer benefits on the public, but air transport ought to be able to do far more for the world if it is resolutely pushed ahead on its own.

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AERIAL GUN LIMBER: From being one of the poorest-armed bombers the Fortress has become one of the most heavily armed. Fighters attacking the white-painted Coastal Command Fortress from the angle shown in this photograph would come under the fire of no fewer than eight ·5in. machine guns. Accounts of anti-submarine patrols by Fortresses in the Battle of the Atlantic have also referred to attacks with depth charges and of raking submarines with cannon fire.

WAR in the AIR

Sqn. Ldr. D. E. Kingaby, D.S.O., D.F.M. and two Bars, takes the Spitfire IXs of the Bombay Squadron out for an airing.

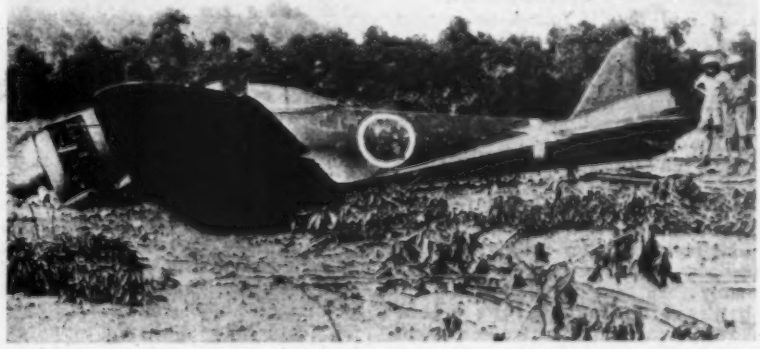
Allied Air Supremacy in the East : The Red Air Fleet in the Donetz Basin : Axis Air Apathy in Tunisia

THE continued probing of the British and Indian forces in the Arakan district of Burma roused the enemy to reinforce his troops in that sector and undertake a rather serious counter-attack against us. The British staff had expected it and was prepared for it, and the reports indicate that it did not achieve much, if anything. All the fighting and skirmishing in that part of Burma is excellent training for the British and Indian regiments in jungle fighting, in which the Japanese were undoubtedly more skilful at the time of their conquest of Malaya and Burma.

What is very certain is that in Burma the R.A.F. and the Americans hold a clear air superiority. Fighters and bombers are constantly out on the raid, sometimes in combination and sometimes independently. They have struck repeated blows at Japanese lines of communications, especially at railway bridges, and they are continually taking toll of the enemy's river transport. Burma is a land not well provided with communications, and so every interruption to those which exist has a more far-reaching effect than it would have in a country where there were many alternative means of moving troops and supplies.

It is extremely satisfactory to note the very low rate of casualties suffered by the R.A.F. and the American squadrons in these operations. The Zero fighters, which were so formidable in the conquest of Malaya when they were hardly opposed, and could get the better of the Buffalo fighters (though easily outmatched by the Hurricanes, which arrived too late and in too small numbers to produce their due effect), seem now to count for little. Even unescorted bombers from India usually reach their target, bomb it, and get home, with little or no damage to themselves. This promises well for the time when the reconquest of Burma is undertaken in earnest, though it must be remembered that much of the country is jungle, and that when fighting is taking place in thick forest aircraft can play no part in it. But in the recent fighting in Arakan R.A.F. fighters and bombers gave close support to the infantry with excellent results.

The Japanese convoy which was attacked by Gen. MacArthur's bombers and fighters as it was making for New Guinea turned back after its heavy losses. The transports were packed with Japanese soldiers, and they lost heavily when American fighters (or were they Beaufighters?) flew low and raked their decks. During the engagement one Allied machine was lost. It must have been shot down by A.A. fire from the ships, as no Japanese fighters were encountered. The convoy had taken a circuitous route, evidently hoping to escape observation, and the conclusion must be drawn that the Japanese are not willing to risk any of their remaining



BATTLE FOR BURMA : A Japanese Navy 97 fighter shot down near Chittagong, East Bengal.

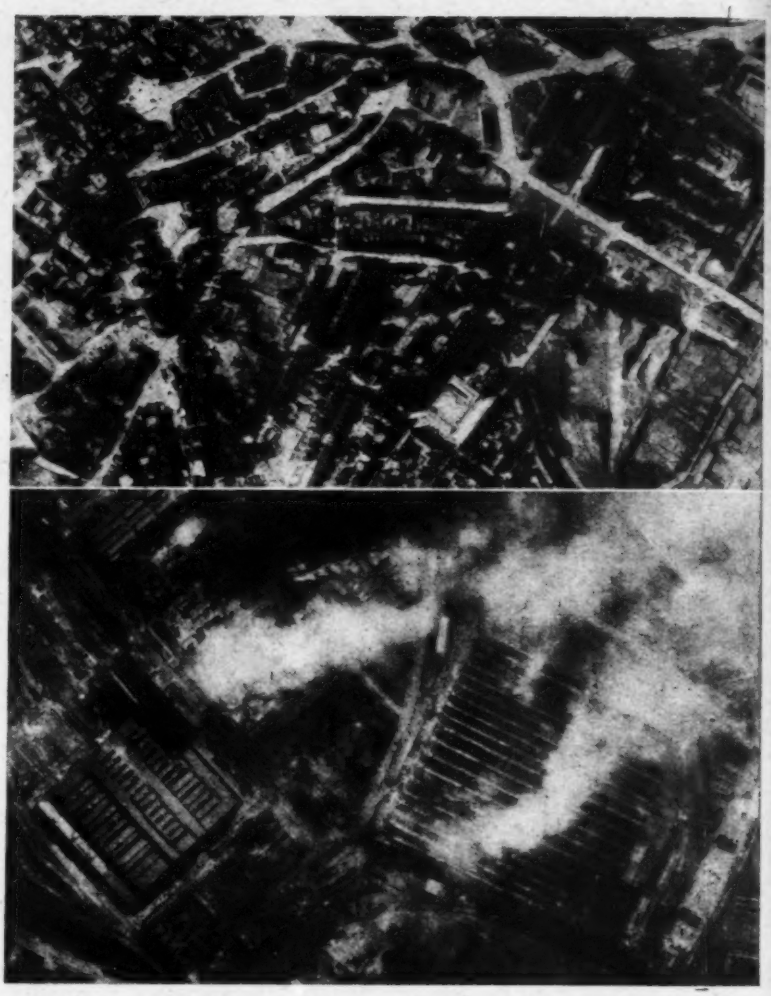
WAR IN THE AIR

carriers on convoy operations. As a result the convoys are practically helpless when resolutely attacked by Allied aircraft. The Japanese do not yet seem to have developed a catapult fighter. Such good copyists as they are must have noted the success of the catapulted Hurricanes in the Atlantic and have considered the possibility of using this device. But catapult machines could hardly be present in sufficient numbers to drive off a mass attack of land-based bombers. In the Atlantic they have been used chiefly for dealing with "snooping" Condors far out in the ocean. Moreover, it may be that the Zero is not of sufficiently robust construction to permit of its being adapted for catapulting.

The *Luftwaffe* in Africa

A STRANGE apathy seems to have affected the *Luftwaffe* (one hardly counts the *Regia Aeronautica* nowadays) in North-West Africa. The bad weather and wet ground have persisted longer than usual this year in Tunisia, and that has hampered air activity. Spring is expected at any time now, and the sun will soon dry the flying fields. Despite all difficulties the R.A.F. and the American Army Air Force have managed to put in a lot of flying hours. When Rommel attempted his futile sallies from the Mareth Line, R.A.F. fighters and bombers of what is still called the Western Desert Force showed the greatest energy in attacking the Axis troops and positions, and gave all possible help to the ground troops of the Eighth Army in its successful repulse of the enemy. This ground-air cooperation has been brought to a fine art in the Eighth Army, and the methods employed are being studied in the United Kingdom as a model of what such things ought to be. A very different state of affairs seems to have prevailed behind the enemy's lines, despite the *Luftwaffe's* tradition of perfect training as an arm of the German Army, though under separate command. Two masterful men have led the Germans, Rommel and Kesselring, and one is forced to wonder whether they have always worked in that unison which is so essential if the best results are to be attained. Another possibility which has occurred to some observers on the spot is that the long period of inferiority in the air which the *Luftwaffe* has had to endure may have sapped to some extent the fighting spirit of the pilots. It would not be safe to put too much weight on that possibility, for the Germans are a dogged race. One remembers how badly their aircraft fared during the battles of the Somme in 1916, and how strongly their fighters made a comeback under the leadership of Boelcke.

Whatever the cause, the German fighter squadrons in Tunisia have made a poor showing of late. When the Americans recaptured Gafsa last week, the attack, despite bad weather, was assisted by determined action by both bombers and fighters which shot up troops and vehicles with great effect, and met with hardly any opposition in the air.



CRUMPS FOR KRUPPS: Photographs taken after the second heavy raid on Essen. (Top) Scarcely a roof remains intact in the area of the town adjacent to Krupps. (Bottom) Some of Krupps vast production sheds still on fire the day after the raid. The building on fire on the right has an area of 85,000 square yards.

The Red Air Fleet

AT last some news has come to hand of the Russian Air Fleet. We had heard that the Germans had been bombing Kharkov night and day before they recaptured that unfortunate town, and at that time nothing was reported of a Russian riposte in the air. Towards the end of last week the news came through that our Allies had brought up powerful units of their air arm into the Donetz Basin. The German dive-bombers which attacked the Russian gun posts were met by Russian fighters, and Stormoviks made frequent audacious attacks on the enemy's tanks. It is most important for the Russians to be able to keep their artillery in action, for they have relied on this arm to a very great extent throughout their spirited winter campaign, and they have found gunfire the best way of stopping the German tanks. We have found the same in Africa; tank-buster Hurricanes have been useful, but guns, either on the ground or in tanks, have proved the best way of stopping the once almost irresistible charges of the German armour. The Russians have also relied mainly on their artillery to break up the German defences round what used to be called the Hedgehog posts. At the end of last week the Russians had taken up a defensive position along the Donetz River, which the Germans were assaulting with great fire. It was quite time that the gallant Russian gunners and infantrymen received adequate air support. There were probably difficulties in moving the ground equipment of their air squad-

WAR IN THE AIR

ENEMY AIR LOSSES to MARCH 20th

	Over G.B.	Over Continent	Middle East
Mar. 14	2	2	0
,, 15	4	0	1
,, 16	0	0	5
,, 17	0	0	3
,, 18	4	2	3
,, 19	0	0	0
,, 20	0	0	4
	10	4	16

Totals: West, 6,725; Middle East, over, 5,265; North Africa, 832.

rons during the partial thaw, but the feat seems to have been accomplished before it was too late. Up on the central and northern fronts, where the Russians are still advancing manfully, news of air activity has continued of late to be very scanty, but probably more has happened in the air than has got into the communiqués.

Here and There

A RECENT daylight raid by Mosquitoes on the railway repair works at Paderborn, in Germany, was a notable performance. These works are busy repairing locomotives and wagons, of which Germany is now perilously short. Paderborn may be too far away to deal with the numerous engines which are daily getting holes through their boilers and other damage from the cannons of the Mustangs and Fighter Command aircraft in Northern France, but in all parts under German control there has been tremendous wear and tear on rolling stock in the last two years or more, and so repair shops are a very valuable part of the enemy's war effort. Apart from the importance of the target, the remarkable thing about the raid was that the Mosquitoes made a return flight of some 600 miles, of which 500 was over hostile country. They spent from two-and-a-half to three hours over that territory, and only lost one machine. What a contrast to the sneak raids in which the Germans are now indulging almost every day, in which their average time spent over British soil is about three minutes! They make no attempt to damage repair shops, but wreck women's hostels and girls' schools. *And*, they often lose machines.

GUNGA DIN, 1943: E.C.D. purifier units at work at a water source in North Africa. A supply of drinking water is one of the most important necessities of an air force in the field.

Another profitable raid was made some days later by Whirlwind twin-engined fighter-bombers. An article on a Whirlwind squadron was published in *Flight* of March 11th. This raid was made by night, and the moon has been a help on recent raids. The target was the 300ft. high viaduct at Morlaix, which lies on the main railway line to the Atlantic U-boat bases. It is not claimed that the viaduct was destroyed, but several hits were made, and repair work on such a structure cannot be an easy or rapid matter. It is to be hoped that this has caused a further hitch in the U-boat war against Allied shipping across the Atlantic.

The raid was repeated on the following night, again by Whirlwinds, and the results were similar.

On the other side of the picture, the Japanese made another raid on Darwin on March 15th. It is some considerable time since their aircraft are reported to have visited Australia. They took precautions, sending 25 medium bombers with an escort of 24 fighters. Then, for the first time, we believe, they met the Spitfires. Twelve Japanese Zero fighters and two bombers paid the penalty for their temerity, and were shot down, while others were damaged. Four Spitfires were lost, but their pilots are safe, presumably having come down by parachute. The bombs caused few casualties and only slight damage.

Montgomery Moves

BY the time these words are in the hands of our readers much may have happened. But the preliminaries were dramatic. The Germans, evidently in a nervous frame of mind, stated that the big battle had begun, and then they reported that a force of 50 tanks and 2,000 vehicles had started moving from the area of Ksar Ghilane towards the coast. Ksar Ghilane marks the western end of the Mareth line, and there have been indications that the Eighth Army was probing thereabouts. Next, while the official communiqués spoke only of patrol activity and air action, the Prime Minister told the world that he had heard from Gen. Montgomery that the Eighth Army was on the move. The battle opened with a terrific air bombardment from all directions on the Mareth positions and on those opposite Gen. Alexander's forces. It was the regulation bursting of the storm. The motto for opening a modern battle might be: "Shell what you can and bomb what you can't."

LA PREMIERE LEÇON: An open-air lesson in French to help the Royal Air Force men in their dealings with the local population in Tunisia.

BRITISH & U.S. AIR LOSSES to MARCH 20th

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'ters.	Middle East A'crft.
Mar. 14	0	0	4	0
,, 15	0	1	0	0
,, 16	0	1	0	0
,, 17	0	0	0	0
,, 18	0	0	0	0
,, 19	0	0	0	0
,, 20	0	0	0	0
	0	2	4	0

Totals: West, 5,417; Middle East, about 2,086; North Africa, 347 (4 pilots safe).

HERE AND THERE

Higher Power Fuel

PRODUCTION of the higher octane type of aviation petrol has now been started in America. It is claimed that this fuel will give from 23 to 35 per cent. more power to supercharged aircraft engines.

Lend-Lease

UNDER the Lend-Lease agreement the Allies have received 30 out of every 100 bombers produced in America in the last year, and 38 out of every 100 fighters.

Mr. Edward Stettinius, Lend-Lease Administrator, states that American aid to the Allies now totals £2,408,000,000.

Air Patrols for U-boat Menace

ADMIRAL G. P. THOMSON, Chief Press Censor, said recently that the answer to the U-boat menace was more escort vessels and sufficient aircraft for patrolling over convoys, rather than faster merchant ships.

A U-boat which was trying to approach a convoy on the surface would be forced to dive while miles from its object, and, once submerged, the U-boat would never get within striking distance owing to its lower speed.

New A.R.C. Chairman

PROF. SIR B. MELVILL JONES, C.B.E., A.F.C., F.R.S., F.R.Ae.S., has been appointed Chairman of the Aeronautical Research Committee, thereby succeeding Sir Henry Tizard, K.C.B., A.F.C., F.R.S. Prof. Sir Melvill Jones, who has been a member of the Aeronautical Research Committee for some years, is Professor of Aeronautics at the University of Cambridge.

New Wind Tunnel

FOUR American aircraft firms—Consolidated, Douglas, Lockheed and North American—are jointly financing the building of a new wind tunnel at Pasadena, California, the cost of which is reported to be about $2,100,000. It will test at speeds up to about 700 m.p.h.

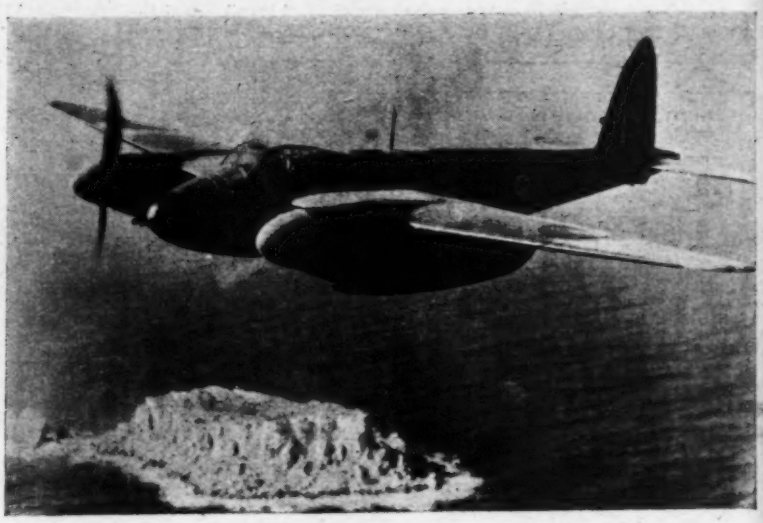
An identical tunnel is also being built by Curtiss-Wright at Buffalo, New York, all five firms having collaborated in its design.

Boston-London in 14 hrs.

NORTHEST AIRLINES INC., of America, has filed an application with the Civil Aeronautics Board for permission to establish North Atlantic air routes from Boston (Mass.) to London, Paris, Moscow, Amsterdam and other European cities.

The use of large, high-altitude, high-speed airliners is anticipated, bringing Moscow within eighteen hours and London within fourteen hours of Boston.

This is said to be the first application of its kind by a domestic airline. Evidently, Northest Airlines Inc. do not mean to be left behind in the matter of international air services when the shooting stops.



STING IN ITS NOSE : de Havilland Mosquitoes operating in the Mediterranean area have been "stinging" the Axis hard and strong in Sicily, Italy and North Africa, and here is one over a small island near Malta. The ·303in. machine-guns protruding from its nose are clearly seen.

F. G. Miles on Future Air Transport

MR. F. G. MILES, of Phillips and Powis Aircraft, Ltd., in speaking of the Government's decision to start with plans for new types of civil transport planes, said recently: "There is no case for cut-throat competition with other countries. We may trust to the good will of the Governments of our own and other countries to agree, even if somewhat belatedly, on measures to prevent the evil effects of unbridled national competition."

Controller for Short Bros.

THE Minister of Aircraft Production, Sir Stafford Cripps, has appointed Mr. Arthur A. Layton-Bennett to be authorised controller of Short Bros., Ltd., and has stated that this should "strengthen" the position of Sir Frederick Heaton, the firm's recently elected chairman.

Sir Frederick, chairman and managing director of Thomas Tilling, was elected chairman of Short's in February on the resignation of Mr. H. O. Short, but, in the reported words of Sir Stafford Cripps, "certain difficulties which have arisen in the carrying out of the chairman's duties" have caused him to appoint an authorised controller in order to "safeguard production."

To Boost Brewster's Output

MR. HENRY J. KAISER, the United States shipbuilder, has been made chairman of the Brewster Aeronautical Corporation's new board. He will not be paid for his services, his interest being that of stepping up production, which, so far, is reported to have been unsatisfactory.

At present building dive-bombers for the U.S. Navy, the three factories of the Brewster company have Government contracts amounting to £64,000,000, and Senator Harry Truman recently described the programme at their Newark (New Jersey) plant as "a sad disappointment" after his Senate investigating Committee had paid it a visit.

New Mexican Trainer

BECAUSE he needed some primary trainers urgently, General Roberto Fierro, head of the Mexican Air Force, collaborated with one of their leading aircraft engineers, Antonio Sea, in the design of a light tandem two-seater low-wing monoplane to be built entirely of "native materials" except for engine and instruments.

Known as the Teziutlan, it is powered by a 125 h.p. flat-four, air-cooled Lycoming engine, and tests of the prototype are said to have produced a top speed of 110 m.p.h., a landing speed of only 24 m.p.h., and a ceiling of more than 25,000ft.

The enterprising General also arranged for production.

No Surprise

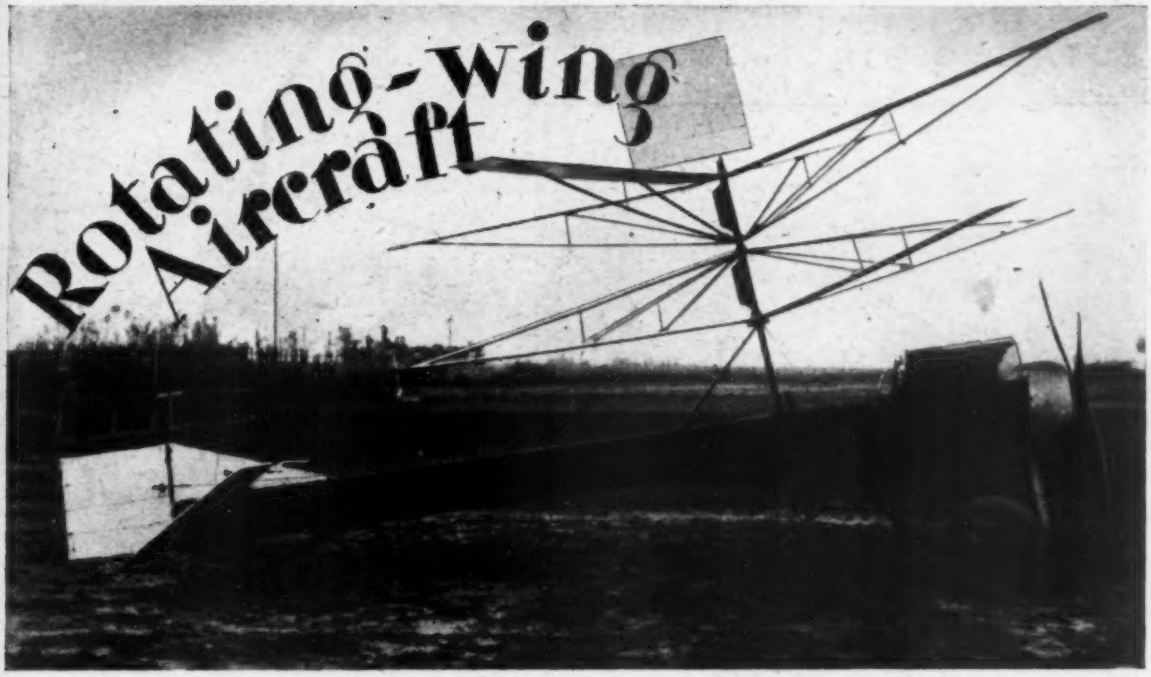
THE appointment of Air Chief Marshal Sir Frederick Bowhill as A.O.C.-in-C. Transport Command came as a surprise to nobody, for he was pre-eminently the man for the job.

Least of all could it have surprised Mr. Stokes, the honourable Member for Ipswich, who enlivened the Commons debate on the Air Estimates by an attempt to persuade Sir Archibald Sinclair either to confirm or deny newspaper "anticipation" of this appointment. But Sir Archibald insisted that no decision on the matter had then been reached.

Mr. Stokes, however, said: "I am going to assume the newspaper is right," and added that, if not, no doubt the Secretary for Air would take the advice of the newspaper which published the statement.

Apparently it was—or he did!

Rotating-wing Aircraft



The first Cierva Autogiro had coaxial contra-rotating rotors. Note that the blades had lift bracing.

From Helicopter to Gyroplane and Back to Helicopter : Earliest Envisaged Aircraft Type Becomes Latest : Lift Foreseen, but Stability and Control the Difficulty

Illustrated by "Flight" photographs and sketches

THE recent announcement by Capt. Harold Balfour, Under-Secretary of State for Air, that this country has placed orders for helicopters in America, has focussed attention on a type of aircraft which would have obvious advantages in connection with the anti-submarine war.

Rotating-wing aircraft, that is the type with thin flexible blades rotating on a vertical axis, have long attracted designers. Gyroplanes, and more recently helicopters, have formed the subject of continuous experiments. These notes indicate the trend of progress with gyroplanes and a later instalment will discuss more particularly the developments in helicopters.

AVIATION history has been full of examples of original ideas, good in themselves, being taken up, and then, before reaching maturity, scrapped because unforeseen difficulties had been encountered and other alternatives, more easily developed, had been found. The history of the direct-lift, or helicopter, type of aircraft is a case in point. Leonardo da Vinci, who appears to have thought of almost everything mechanical, foresaw the broad general principles.

If we pass on to relatively modern times it is found that among the earliest experimenters there were several who began by devoting their attention and inventive genius to the helicopter. Two names in particular which are famous to-day were originally linked with helicopter research. In Russia, Igor Sikorsky designed, calculated and experimented. In France it was Louis Bréguet. Their calculations indicated that it should be possible to obtain the necessary lift from an airscrew revolving in a horizontal plane, and model experiments proved this contention, or rather confirmed the results obtained by the Chinese hundreds of years earlier, for probably our Allies in the East were actually the very first to send helicopter toys into the air.

However, it was one thing to prove by calculation, and demonstrate by means of models, that a direct-lift aircraft could fly; it was quite another to design and fly a full-size, man-carrying machine. Petrol engines were, in those days, of low power and very heavy. A power of 30 to 50 h.p. was quite common, and the weight might be as great as 7 or 8 lb. per horse-power, compared with the modern aircraft engine of 2,000 h.p. or more and a weight of 1 lb. per horse-power.

To add to the troubles of the early designers, even when they had schemed the mechanism they were still faced by the problems of control. And remember that in those days little was known about aerofoil sections, location of centre of pressure, stalling of sections, and a host of other subjects

The first Autogiro to appear in this country was Cierva's No. 6. It had an Avro 504 fuselage, and ailerons were used for lateral control.

ROTATING-WING AIRCRAFT

Four Autogiros of the pre-jump-start era. In the top right-hand corner is the C.30, called the Rota by the R.A.F. A small Comper is shown in the top left-hand corner. On the left is a De Havilland Autogiro, and above the Westland-Lepere.

which to-day we almost unconsciously take for granted.

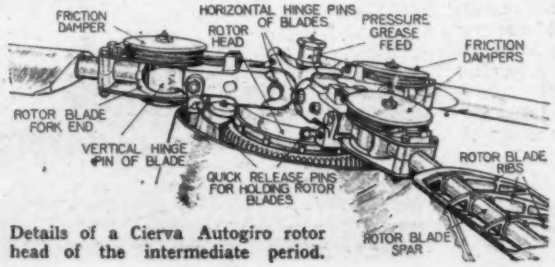
The Wright brothers in the United States of America, the Voisin brothers and Farman brothers in France, and the Short brothers in England were beginning to achieve limited success with fixed-wing aircraft, so that in view of all these difficulties it is scarcely surprising that the early helicopter protagonists shelved their schemes in favour of a class of aircraft which promised greater immediate prospects of practical results. Do not let us blame these pioneers for taking the line of least resistance. They were ahead of their time, and theirs was not the happy lot of the inventor with Government backing and vast funds for research.

Temporarily Ousted

Following in the footsteps of Sikorsky and Bréguet were a few enthusiasts who persevered, and during the war 1914-18, when the fixed-wing class of aircraft was establishing itself firmly, there were a few, a very few, who managed to carry on. However, their labours did not bear fruit, although a measure of success was achieved by one or two, and after the war, when retrenchment became the watchword everywhere, no Government was willing to spend money on schemes which appeared somewhat nebulous.

When Europe began once more to get its economy and finances established, and the worst of the slump seemed to be passing, several nations began to take a new interest in the problem of the helicopter. The British Government offered a prize for a helicopter, conditionally upon certain specified performances being satisfied. The taxpayers' money appeared fairly safe, since no helicopter had ever come within measurable distance of giving consistent and really useful results. Considerable sums had been spent on the development of the Brennan helicopter. This machine, designed by the inventor of the "monorail" system, had been built by Government funds, the final stage being a crash in the large shed at the Royal Aircraft Establishment, Farnborough. The main trouble with the Brennan, as with earlier and many subsequent helicopters, was that of control. From first principles, as already mentioned, it was known that flight by direct lift was possible.

In France M. Michelin offered a large prize for a helicopter. Two names became prominent in connection with the helicopter designs encouraged by the Michelin prize: Damblanc and Pescara. M. Louis Damblanc lectured to the Royal Aeronautical Society on helicopter theory, and M. Pescara got so far as exhibiting a helicopter at a Paris aero show. But success eluded the designers in all countries. The theory was imperfectly understood, and there were too many variables for the different parameters to be defined. Much research was still needed to settle problems.



Details of a Cierva Autogiro rotor head of the intermediate period.

When it began to look as if the helicopter was doomed to failure, something happened which was to be instrumental in reviving it, although by a roundabout way, and after a considerable lapse of time: a Spanish gentleman, Señor Juan de la Cierva, conceived the notion of a class of aircraft in which the lifting screw was not driven directly by

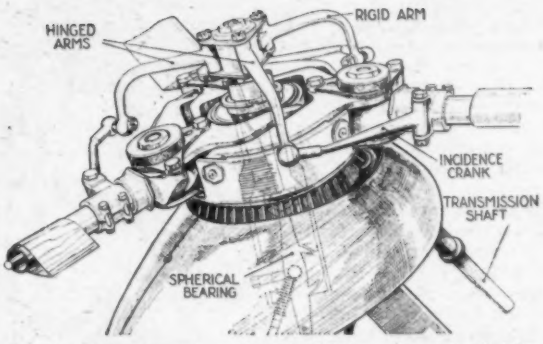
the engine, but was kept going by the air forces on its blades. To a degree this idea side-tracked the helicopter, but the vast amount of experimental work done on the Cierva Autogiro, as he called it, established certain fundamental facts which put the theory of rotating wings on a sound basis.

Señor de la Cierva conceived the idea of a windmilling lifting screw in 1919. For several years this modern, real-life Don Quixote tilted against the recalcitrant windmills unaided by Government funds, but by the time he had built and flown (more or less) five of these machines, the Spanish Government had become convinced of the practicability of his ideas, and agreed to defray the expense of No. 6.

The first Autogiro had contra-rotating, coaxial lifting screws. We give a picture of this machine, from which it will be seen that the blades were braced downwards by lift wires. Señor de la Cierva found that although the upper screw gave the lift which he had previously calculated, the lower gave far less, showing that there was serious interference between the two screws, at any rate as then designed.

Hinged Rotors

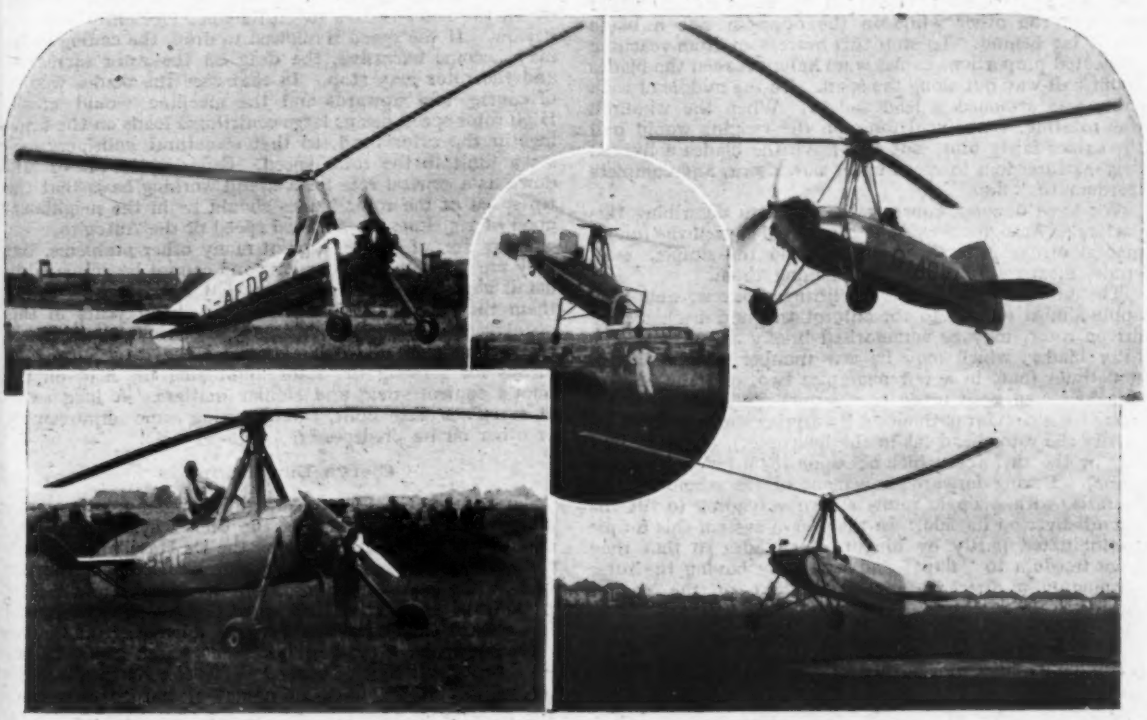
In his next Autogiro Señor de la Cierva used a single lifting screw, but found that although the machine would lift, it crashed by tilting over to the right. He tried to cure this tendency in No. 3 by using five blades in conjunction with a divided elevator, the idea being that by moving one elevator flap up and the other down, a torque could be established opposite to that of the rotor, as the lifting airscrew is called. Some improvement was attained, but the machine still persisted in tilting to the right.



In the Hafner gyroplane the rotor blades were controlled by means of a "spider," operated by the control stick.

It was in 1922 that the idea occurred to Señor de la Cierva which was to put the Autogiro on the royal road to success. The reason why the earlier Autogiros had tilted was that, as seems obvious now but was not realised in those days, the advancing blade was subject to its own rotational speed plus the forward speed of the aircraft as a whole, whereas the retreating blade had the translational speed subtracted from its rotational speed. As a result, there was more lift on one side than on the other, and the machine tilted to the right (the rotor rotated clockwise as seen from above).

Señor de la Cierva thought that if he hinged the rotor blades at the root around horizontal hinges, the blades would be free to "climb" slightly on the forward portion of their travel and drop slightly on the rearward. Thus the lift on the two sides should be equalised. Machine No. 4 incorporated the hinged blades, and so far as the rolling was concerned they did what was expected of them, but control was very heavy with the form of mechanism employed for tilting the rotor axis, and was beyond the power of the pilot. However, the value of the hinged blade, free to "flap," as it became known (although the expression may be somewhat misleading to the uninitiated), had been proved, and the rest was a matter of detail development and mechanical improvement.



Jump-starting was the last stage on the road to real helicoptering. Here are five jump-start gyroplanes. In the top left-hand corner is a Cierva C.40 Autogiro making a spot landing without forward run. The machine in the top right-hand corner is the Kay, which had a four-bladed rotor. Two Autogiros with two-bladed rotors are shown inset and bottom left, the former being the Weir W.3 jumping into the air, and the latter a Cierva. The Hafner gyroplane is seen taking off in the bottom right-hand corner.

ROTATING-WING AIRCRAFT

By 1925 Señor de la Cierva had built machine No. 6, which was paid for by the Spanish Government. In the same year he brought to this country a duplicate in all essentials of that machine, and it was demonstrated at Farnborough (on Laffan's Plain) by Captain Frank Courtney.

The picture of the 1925 Autogiro is apt to make one smile now, but that machine actually laid the foundation for the development which was to follow, and for which Lord Weir and his brother, Air Commodore J. G. Weir, have never been given sufficient credit. We have no means of knowing how much money the Weir brothers put into the Autogiro, but it must have run into hundreds of thousands (a fact which, incidentally, explains why progress with rotating-wing aircraft has been so slow).

Briefly explained, the 1925 Autogiro consisted of the fuselage of an Avro 504 on which was mounted the pylon which carried the rotor head. Sprouting from each side of the fuselage was a beam, rather like a wing spar, which carried an aileron for lateral control. The usual tail control surfaces of the 504 were retained for directional control and for climb and descent.

Starting-up

The method of starting the rotor was crude in the extreme: each rotor blade spar had a cleat placed a few feet out from the centre. Around the cleats was wound a cable, and when the engine had been warmed up several men tailed on to the cable and "ran it out" as fast as they could. As soon as the inner end of the cable fell clear, the pilot began his take-off run, which was sometimes protracted before the machine could be coaxed into the air.

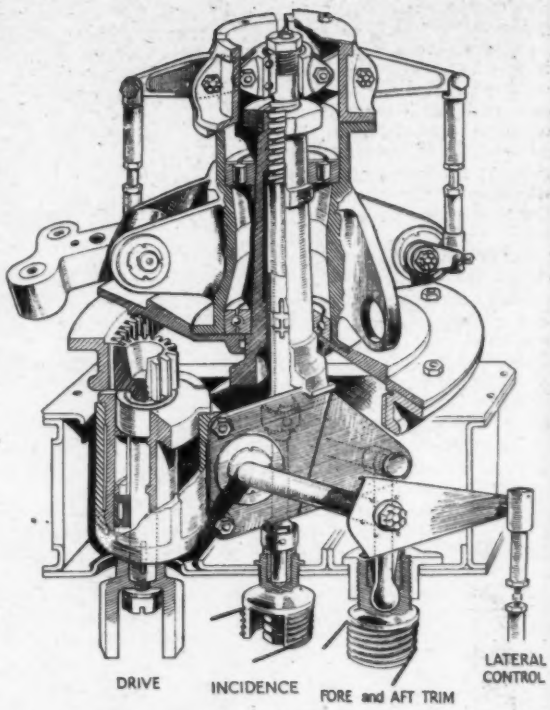
In addition to their "flapping" movement, the rotor blades had a tendency to a cyclic speed variation on their way around the circle of travel; at one point a blade would overtake the other while on the opposite side a blade would lag behind. To stop this movement from reaching unwanted proportions cables were hung between the blades about half-way out along the span. To the middle of each cable was attached a lead weight. When the windmill was rotating, centrifugal force on the weights would pull the cables fairly taut, but still leave the blades a limited degree of freedom to speed-up or slow down, and complete freedom to "flap."

We have devoted considerable space to describing this particular Autogiro because it illustrated so well the fundamental obstacles to be overcome, and the simple, even crude, means adopted for overcoming them.

The broad principles of the lifting airscrew, and they apply almost equally to the autorotating and mechanically driven rotor, may be summarised briefly as follows: The rotor blades, which may be any number (usually three, sometimes four, in a few examples two, and the suggestion has even been made to use one) are made to travel along their circular path either by driving the spindle which carries the rotor head (as in the helicopter), or automatically by the air forces which act upon them (as in the gyroplane). During forward movement of the whole aircraft there is, with a single rotor, a torque tending to tilt the aircraft over on its side. In the Cierva system this torque is eliminated partly by hinging the blades so that they have freedom to "flap" and partly by having the rotor running in a direction opposite to that of the tractor airscrew.

Balancing Natural Forces

Fundamentally, the beauty of the hinged-blade system is that centrifugal force on the blades counteracts the lift, so that the loads on the blade spars are mainly tensile. When an Autogiro is flying it is observed that the blades are not quite horizontal but slope upwards slightly from root to tip. This angle, known as the "coning angle," represents the resultant of centrifugal force and lift.



In the Kay gyroplane the blades were controlled via a threaded shaft and Z-shaped cranks. Incidence of blades was decreased for speeding-up the rotor for a jump start.

It will readily be seen that the range of speeds through which the rotor is able to do its work efficiently is fairly narrow. If the speed is allowed to drop, the coning angle may become excessive, the drag on the rotor increases, and the rotor may stop. In that case the blades would, of course, fold upwards and the machine would crash. High rotor speed means large centrifugal loads on the bearings in the rotor head, so that structural considerations set a limit to the rotor speed. Señor de la Cierva laid down as a general rule for a useful working basis that the tip speed of the rotor blades should be in the neighbourhood of 1.5 times the forward speed of the Autogiro.

There are, of course, a great many other problems, but they are by way of refinements and cannot be discussed in detail here, except to point out that it was on perfecting them that Señor de la Cierva spent many years in this country, assisted by a very able staff of technicians. These refinements related to the design of the rotor head, the means for starting the rotor, lightening the load on the pilot's control stick, and similar matters. A long series of machines were built, each showing some improvement or other on its predecessor.

Cierva Developments

Apart from the Cierva Autogiro Company, other firms built machines incorporating the Cierva system. In this country machines were built by the De Havilland Aircraft Co., Ltd.; Westland Aircraft and by Compex Aircraft, Ltd., while in America there were the Pitcairn and Kellett Autogiros. In France there was a Lioré et Olivier, and in Germany the Focke-Wulf firm had a licence from Cierva.

So far we have touched but briefly upon one very important aspect, that of control. The fundamentals of the mechanism of lift have been stated, but to appreciate the reasons for the different designs that have been produced it is necessary to understand at least the basic principles of control.

The Autogiro which came to this country in 1925 had, as already stated, ailerons for lateral control and normal

ROTATING-WING AIRCRAFT (CONTD.)

tail surfaces for the other two controls. Many years were spent in developing and perfecting the tilting rotor head which was to enable the machine to be controlled entirely by tilting the head, the tail surfaces being in the nature of fins, or used for trimming only. Very skilful design was needed in order to reduce the loads which the heavy rotating blades could transmit to the pilot's control stick.

A few moments' consideration will show that, apart from the tilting rotor head used by Cierva (by which the whole rotor plane is tilted), it is possible to control a rotating-wing aircraft by varying the angle of incidence, or pitch angle, of the blades in such a way that if it is desired to climb, for example, the incidence is increased over the forward quadrant of the rotor disc. For descending it is increased over the rear quadrant. Lateral control can be obtained by increasing the incidence over a quadrant of disc on one side or the other.

From a mechanical point of view there are, of course, numerous ways in which this can be done. A Scots inventor, Mr. David Kay, worked quietly for some years on his gyroplane, in which not only could the head be tilted to rock the rotor system, but the incidence of the blades could be changed by means of Z-shaped cranks and a screwed shaft which ran up through the head.

In the gyroplane designed by Mr. Raoul Hafner the blades were allowed a restricted degree of freedom in pitch, being attached to the hub hinge by relatively thin tie-rods which the pilot's control could easily twist sufficiently to give the necessary pitch variation. The Hafner rotor was a three-blader, and mounted above the rotor head was a "three-legged spider" linked to the blade roots. Bodily vertical movement of the "spider," caused by the pilot's control, increased or decreased the pitch angle of all three blades, while tilting of the "spider" axis caused the blades to perform a cyclic and differential incidence variation, which was used for ordinary flying control. One object of attaching the blades to the head by tie-rods and tilting the "spider" only instead of the entire rotor head, was to reduce the load on the pilot's control stick, and the Hafner AR.III gyroplane was said by pilots to be "very light on the controls."

Brief mention was made earlier in this article to work by the Cierva Autogiro Company on improved methods of starting the rotor (the original, it may be remembered, was by hauling on a cable). The next step was the fitting of a biplane tail, one plane of which could be tilted so as to deflect the slipstream from the tractor airscrew on to the rotor blades, thus setting them in motion. While this speeded-up the starting process, the rotor still did not reach the desired speed without a fair amount of taxying, and it was decided to introduce mechanical starting by gearing the engine to the rotor head via a shaft and clutch. This feature was combined with improvements in the rotor head itself, and the starting was greatly accelerated.

Jump Starting

Having once got the starting mechanism "right," the next step, foreseen in the early days but impossible of realisation on account of imperfect knowledge of the dynamics, aerodynamics and engineering problems involved, was the speeding-up of the rotor to the point where the machine could leave the ground without any forward run at all.

Reverting once more to the early Autogyro, it will be remembered that the blades had a tendency to vary their spacing on their way around the circle, and that they were restrained from too great exuberance by cables carrying lead weights. Vertical hinges allowed the blade spars the necessary freedom, and in later Autogiros friction dampers had taken the place of the weighted cables.

When Señor de la Cierva had developed all the other features of his machine sufficiently to be able to contemplate starts without take-off run, he overcame the problem of incidence reduction (necessary to give the blades no lift) in a very simple way: the vertical hinges, which were necessary in any case, were made to serve a double purpose. Instead of being quite vertical they were sloped with their upper ends outwards slightly. The effect of this was to cause the blades, as they swung around the hinges, to increase or decrease their pitch angles.

While the blades were being accelerated by the engine they "lagged behind," and in so doing their pitch angle was decreased to the point where the lift on the blades was almost zero. The drag was, of course, also reduced by this decrease in angle of incidence, and it became possible to speed up the rotor to considerably greater revolutions than those of normal flight.

It was in 1935 that Señor de la Cierva was able to announce, in a lecture to the Royal Aeronautical Society, his "jump-start" Autogiro, and in July of the following year he was able to give a public demonstration at Hounslow Heath of two jump-start machines, one designed and built by the Cierva Autogiro Company, and the other, a small one, by G. and J. Weir, of Glasgow. Before the official demonstration *Flight* had visited the Weir works at Cathcart and the R.A.F. station at Abbotsinch, and had there witnessed a demonstration by Mr. H. A. March, the Autogiro test pilot. Thus we were able to publish in our issue of July 23rd, 1936, a full, illustrated account, the first to be published by any aviation journal, of the design and performance of the Weir W.3 jump-start Autogiro. Moreover, the article was illustrated by cuts from a cine film which showed exactly how the machine behaved during the jump.

Stored Lift

The basic idea of jump-starting was, of course, to enable the machine to take off from almost any piece of ground which would accommodate the Autogiro and give a clear path for the climb after leaving the ground. The speeding-up to revolutions greater than those of normal flight stored in the rotor an excess of energy which was used to give extra "boost" for a few seconds, sufficient to lift the machine several feet into the air. At the top of the jump the machine had become tilted forward by the fact that the centre of gravity was ahead of the centre of lift, and it consequently began to move forward.

During landing the process was, of course, that the machine was "eased down" the last few feet by increasing the angle of incidence of the rotor blades, thus making use of the flywheel energy in the rotor to give extra lift.

In the jump-start Autogiro the incidence was reduced, as mentioned above, by the sloping hinges. In the Kay and Hafner pyroplanes the incidence reduction was effected by the pilot's controls, but the effect was the same.

With jump-starting gyroplanes a great step had been made towards the helicopter, and the great tragedy of that time was the death in an aircraft crash of Señor dé la Cierva, who was a passenger in an orthodox air liner. Before his death he had, however, gathered together a highly skilled specialised staff of technicians, so that the foundation was laid for further development. G. and J. Weir, Ltd., carried on the good work, under the direction of Mr. C. G. Pullin, until the war interrupted progress in that direction. Helicopters were designed and built at Cathcart, and successful flights were made. Details of that work, as well as of that of certain foreign designers, will form the subject of a subsequent article.

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Behind the Lines

Luftwaffe Mercenaries

LATEST addition to the *Luftwaffe* recruits are members of the Dutch Fascist organisation affiliated to the Nazi N.S.K.K. According to Axis sources, 300 members of the "*Motorgruppe Luftwaffe van het N.S.K.K.*," who have just completed a course of training in Belgium were sworn in prior to their joining up.

New Alloy

A GERMAN physicist, Prof. Justi, is reported to have produced a new type of light-metal alloy. The new compound is said to be an excellent conductor of electricity.

Decorations

GENERAL KREYSING, formerly a Commander of a *Luft-Lande-Korps* (Air Landing Corps) and lately in command of a mixed "battle group," received the Oak Leaves to the Iron Cross for the defence of an advanced airfield in Russia.

Among recent recipients of the Knights' Insignia to the Iron Cross are the names of the following *Luftwaffe* men: Col. Otto Lutz-Foerster, an "old-timer," who served with the Richthofen Squadron in the last war, and afterwards played an active rôle in the different Fascist militant organisations (*Frei Korps*) and in the notorious "*Kap Putch.*" Lately he served on the Russian front as air transport leader, and was responsible for air-borne supplies in the Stalingrad sector. Simultaneously with his award Col. Foerster was placed on the retired list.

Col. Wilhelm Wolff, commander of a flak regiment in the Stalingrad sector, Capt. Lamprecht, acting commander of a light flak group, and N.C.O. Bretschneider, Lt. Wilhelm Doering, observer, Oberleutnant Glaeser, leader of a Stuka unit, and N.C.O. Werner Weihrauch, receive the same decoration. Weihrauch has been previously mentioned for the destruction of gun positions in Fort Stalin at Sevastopol. Finally, there are Capt. Eduard Gartenfeld, leader of a reconnaissance unit, and 2/Lt. Goebel, a Stuka pilot who is credited with sinking 50,000 tons of merchant shipping and with damaging the cruiser *Coventry*.

"Aces" and Losses

THE German Press also announces the names of outstanding *Luftwaffe* members on the Tunisian front: Capt. Baer, holder of the Oak Leaves with Swords, is credited with his 154th (*sic!*) victory for shooting down a Boston on February 4th, and "badly damaging a four-engined bomber whose rear gunner's post was completely shot away." Capt. Uebben is credited with his 103rd victory on the same occasion, and Lt. Buchlingen and Oberleutnant Rüdorffer are said to have brought down recently five Spitfires escorting Bostons.

Among *Luftwaffe losses* special mention is made of Lt. Georg Schentke, a fighter pilot, credited with 80 victories, who was shot down on the Russian front, and of Capt. Ludwig Becker, holder of the Knights' Insignia to the Iron Cross, an ace night fighter pilot and commander of a night fighter unit, who is said to have brought down 46 aircraft.

Service and Industrial News from the Inside of Axis and Enemy Occupied Countries

German Savings—

IN a report published by the federation of the German aircraft industry, it is stated that 1,000,000 working hours have been saved in the industry as a result of suggestions received from workers and employees. Twenty-six thousand proposals have been accepted out of a total of 60,000 put forward.

The report adds that, by carrying out these suggestions, substantial savings in material have been achieved, such as considerable amounts of steel, magnesium, copper, chrome and over 1,000 tons of aluminium. A special scheme facilitating the transmission of constructive suggestions from the workers appears to be in operation throughout the industry.

—And Ideas

ACCORDING to neutral reports, an exhibition was recently opened in Switzerland with a predominantly displayed air section. Among these exhibits are German projects for new types of ultra-modern civil aircraft said to be designed by leading German experts and claiming new characteristics and performances.

German A.R.P.

APART from the destruction of German productive centres, the intensified R.A.F. bombing has produced a flood of A.R.P. orders, regulations, warnings, etc. It seems that the Germans, while rigidly enforcing the black-out and the "take-cover" rules, have omitted to educate the public in other precautions. This fact emerges from the new instructions issued almost daily. An interesting instruction published recently in Austria orders all householders to provide clearly marked openings in the walls of cellars leading to the next house. These openings are said to be "of great importance to the safety of the population."

Another instruction published in Western Germany orders that incendiaries must be dealt with immediately. "As they may include a stick of incendiary bombs with an explosive cap (the order says), care must be taken to fight them from cover, viz., from behind walls, pillars, etc. "Wood and iron shields hitherto employed do not accord adequate protection. The jet of the stirrup pump has a range of 22ft., so that at least the area round the bomb can be damped and an extensive fire prevented. Five minutes have to elapse after the fall of the incendiary before it can be assumed that no further detonation will occur, and only then can one deal with the incendiary at close quarters."

Fireworks

THE *Hamburger Fremdenblatt* of the 3rd inst., while cautiously avoiding any detailed description of the R.A.F. raid on Hamburg, expresses its surprise at the new type of flares used by the R.A.F. "The Tommies," it says, "dropped new types of flares which are apparently composed of a multitude of small ones and which fell from the sky like illuminated Christmas trees and radiated powerful red, yellow and green lights."

Jap Planning

IT is reported from Tokyo that a "Southern Resources Scientific Institute" has been formed for the purpose of preparing a survey of natural resources of the Southern regions occupied by Japan. The Institute, which is attached to the Imperial University at Taihoku, the capital of Taiwan (Japanese name for Formosa), is also to draw up a plan for the scientific utilisation of these resources for the Japanese war industry.

MIGRATION SOUTH: The hard-pressed *Luftwaffe* is forced to employ large numbers of Ju 52s to transport reinforcements to Tunisia.

Our friends W. & T. Avery, Ltd., recently approached us, saying that they had noticed our advertising and pointed out the potentialities of confusion that might arise from our use of the name Avery in connection with couplings and hose equipment.

After weighing up the matter we were inclined to agree, and have decided that by reason of their prior use of the name, W. & T. Avery, Ltd., should be given a clear field.

So from now on, please, our self-sealing couplings and hose will be known as:

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Aircraft Types and he

MESSERSCHMITT Me 210

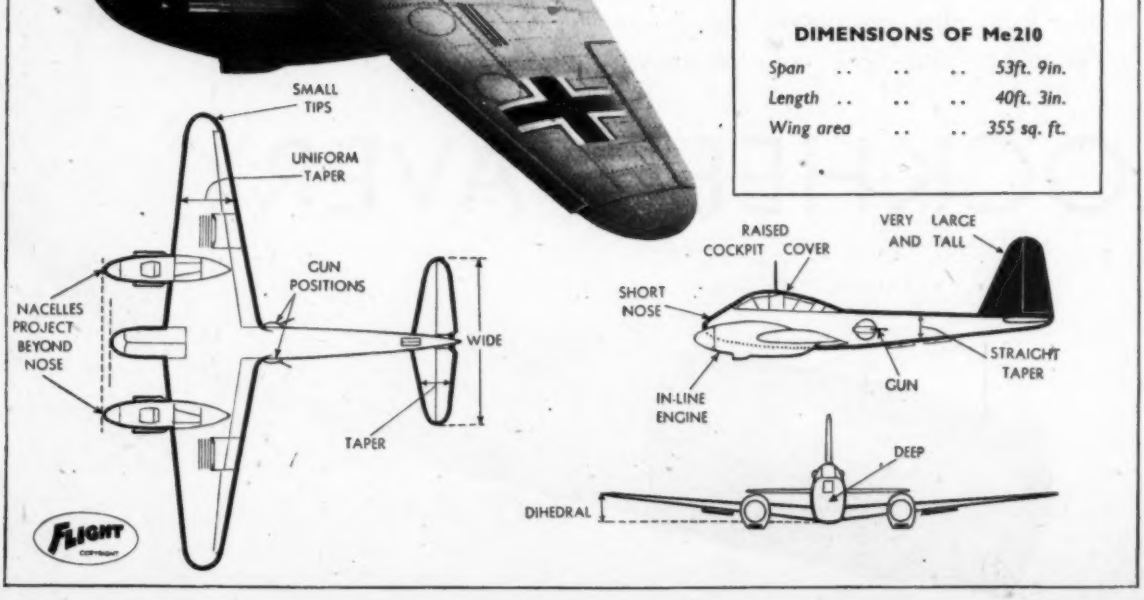
A DEVELOPMENT of the familiar Me 110, the new Messerschmitt Me 210, is a multi-purpose two-seater with an estimated top speed of about 370 m.p.h. It is powered by two Daimler-Benz D.B.601 F.1 liquid-cooled, inverted "V" type, 12-cylinder engines, each providing 1,395 h.p., and it can be used either as a long-range fighter, a dive-bomber, or for ground attacks, though it is probably not so efficient in the first-named capacity as are British designs of similar type, such as the Mosquito, with which, incidentally, it might be confused.

One of the most interesting things about the Me 210 is the provision of two remotely controlled 13 mm. M.G.131 guns mounted in barbettes on either side of the fuselage just aft of the trailing-edge, and operated by the radio operator/rear gunner. These guns, which can be used independently, have an elevation of 35 degrees and a similar angle of depression, while they can also traverse outwards from dead astern to 45 degrees. Forward-firing armament comprises two fixed 20 mm. Mauser cannon and two fixed 7.9 mm. machine guns.

Adequate protective armour for the crew and vital parts of the aircraft (particularly the engines) has been provided, and the fact that this accounts for some 900 lb. of the machine's gross weight of approximately 21,350 lb. would appear to be an acknowledgment of the fire-power of British fighters—and possibly Flying Fortresses, too!

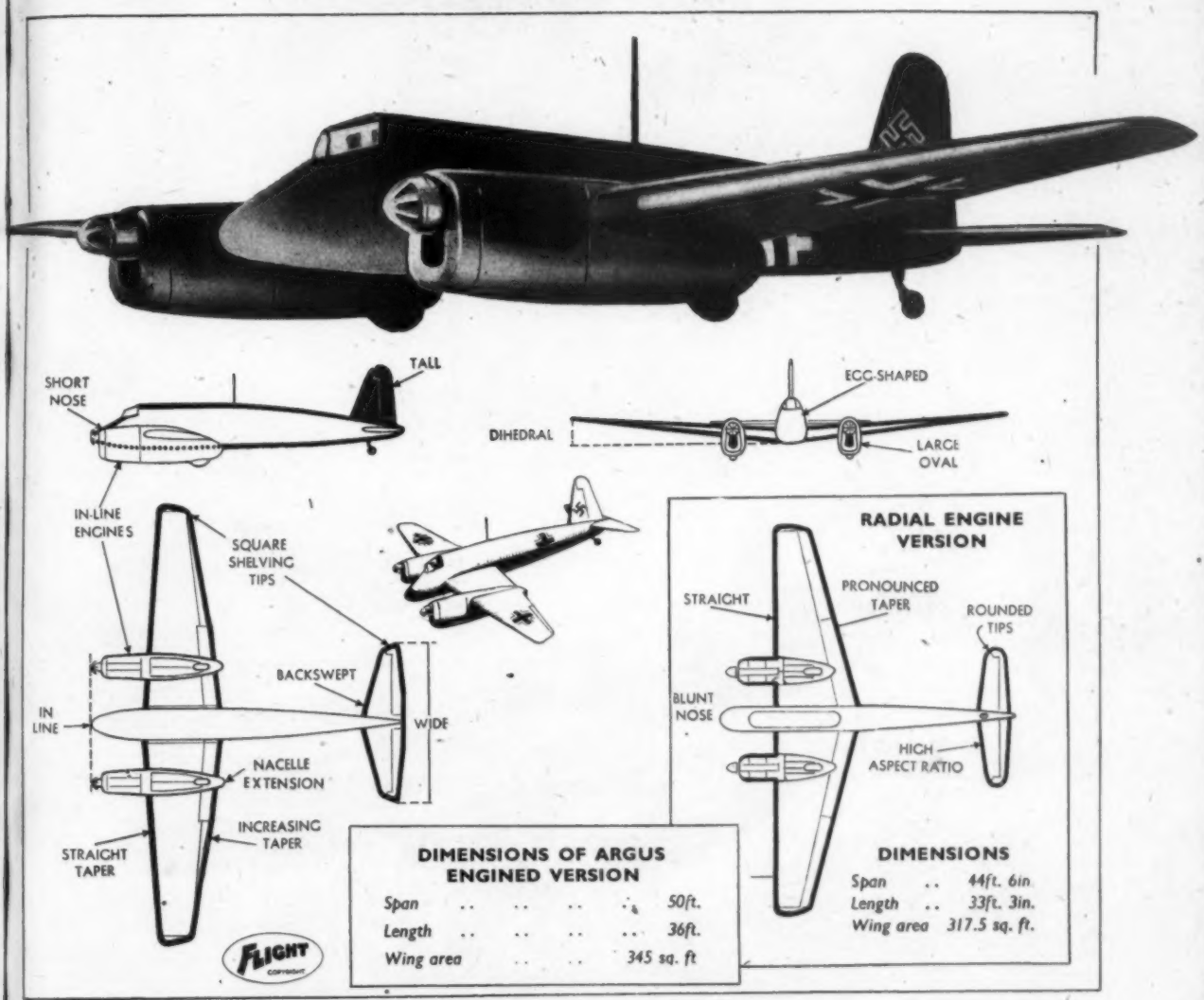
Another interesting feature of the Me 210's design is the parallel-bar type of dive brakes employed; these are so arranged that they lie flush with the wing-profile when not in use, and thus offer minimum drag.

Since, as already stated, the Me 210 bears a fairly close superficial resemblance to the D.H. Mosquito, certain visible differences between these two aircraft should be borne in mind. First of all, the German machine is a low-wing type, whereas the Mosquito is mid-wing. The wings of the Me have a uniform taper in contrast to the straight leading-edge and forward-swept trailing-edge of the "Moss." Also, the nose of the Me is shorter and its cockpit-cover longer, the tailplane is tapered instead of elliptical, and the single fin and rudder also differs in outline.



heir Characteristics

HENSCHEL Hs 129



DETAILS of the new Henschel Hs 129 twin-engined ground-attack aircraft are far from complete as yet, but a recent development is the appearance of a modified version of the original model in which the chief change is the fitting of radial engines in place of the inverted, in-line type first employed.

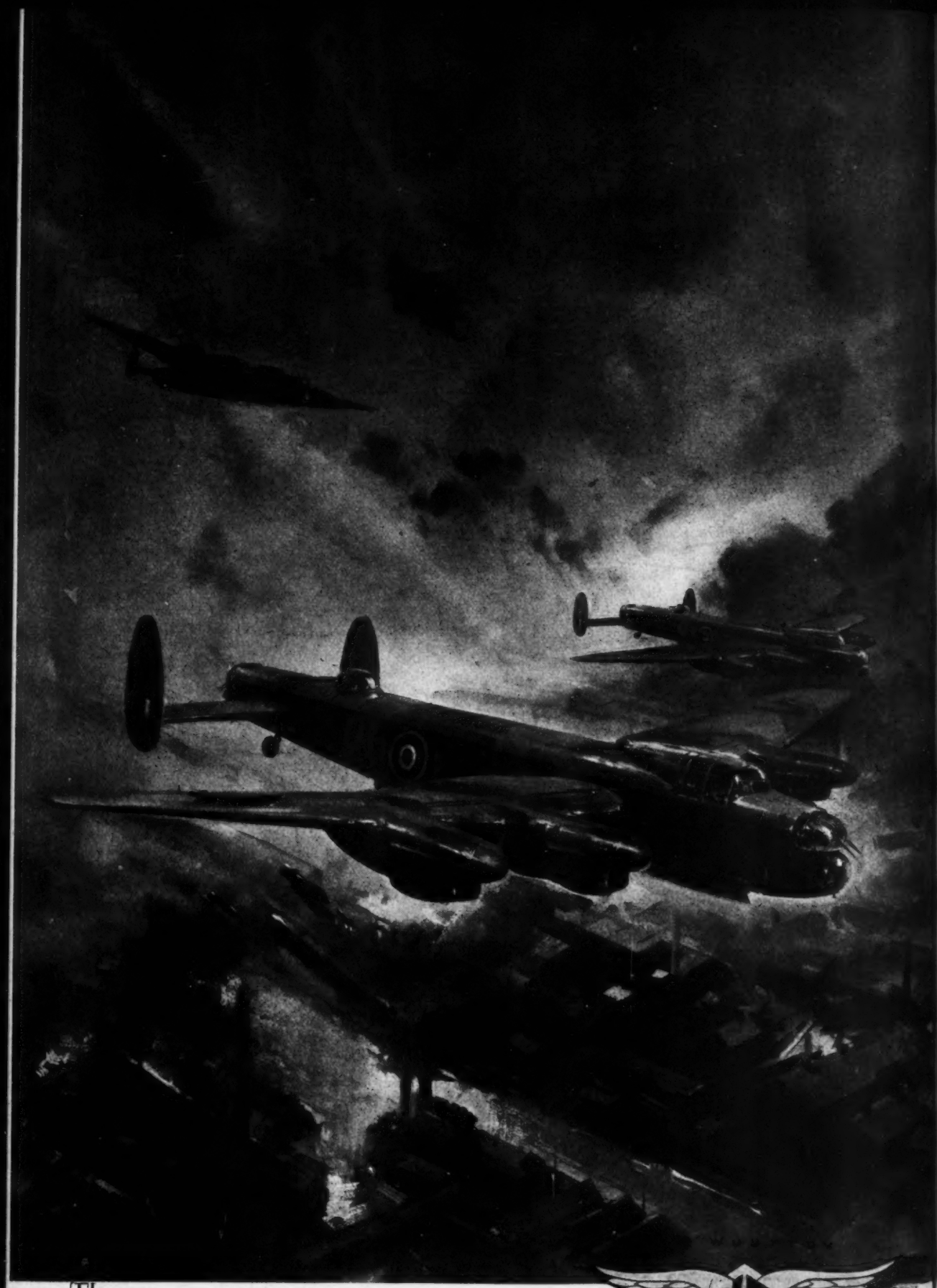
Actually, the "modifications" extend to the wing and tailplane plan and to the dimensions of the fuselage, so that the machine would appear to have been virtually redesigned, and the fact that it is still known as the Hs 129 suggests that the prototype never went into operational service, or, if it did, was subsequently withdrawn in favour of the modified version.

Both types are illustrated above, and it will be seen that the radial-engined Hs 129 is somewhat smaller in overall dimensions, the span, for example, having been reduced from 50ft. to 44ft. 6in. The prototype wings had a constant taper on the leading-edge, but the taper of the trailing-edge increased on the outer panels; the tailplane had a back-swept leading-edge and a trailing-edge on which the taper began approximately at the semi-span. Both wing and tailplane had square, shelving tips, as shown, while the fuselage had a small, almost pointed, nose (in line with the spinners), and tapered gracefully to the rear.

The latest Hs 129, however, which has appeared in Tunisia recently, employs a straight leading-edge and a pronounced taper, or forward sweep, to the trailing-edge, retaining the square shelving tips. The tailplane is of higher aspect-ratio than its predecessor, and tapers more or less uniformly to rounded tips. The fuselage now has a blunt, round nose, and does not begin to taper until aft of the trailing-edge; it is also appreciably slimmer.

That the performance has been considerably stepped-up will be evident from the substitution of two 650 h.p. Gnome Rhone 14M radials for the pair of 450 h.p. air-cooled in-line Argus engines. The top speed, in fact, is now reported to be 285 m.p.h. instead of the previous 225 m.p.h.

Armament comprises a 7.9 mm. machine gun and a 15 mm. cannon on each side of the nose, plus a 30 mm. cannon below the fuselage. The last-named may be replaced by bomb racks.



The **LANCASTER**

AVRO

A. V. ROE & CO. LIMITED

Notes from a Test Pilot's Diary—2

Warming Up

Minimising the Engine's "Agony" Period : Judicious Use of Hot-air Intake and Gills

By "WITNESS"

THERE is probably no other phase of flying or preparing to fly in which the procedure of the test-pilot coincides more closely with that of the ordinary user than of warming up the engine. In this, the ordinary user is, if he obeys the rules, carrying out almost the same drill and making the same deductions as those who have tested the machine before him, whereas in normal flight it is unlikely that he will submit the machine to as exacting treatment as it receives on test. Thus the following notes on warming up, though written expressly from the point of view of test-flying, are just as readily applicable to the work of the Service or A.T.A. pilot.

There was a theory, not many years ago, that the best and kindest way to warm up an engine was to let it tick-over as slowly as the anti-fouling capacity of the plugs would allow, and so increase the temperatures as gradually as possible. The fallacy lay in the fact that during the period of initial warming up, the engine suffered some of its most agonising moments due to the "washing" effect of the raw and imperfectly vaporised fuel. This applies, of course, to the parts of the engine, particularly pistons, sleeves and cylinder walls, which rely on splash for their lubrication.

Whilst the engine is cold, pools, or at any rate overgrown globules of raw fuel, tend to accumulate in every nook and cranny of the induction system. When the pool has become too large to maintain its equilibrium in the draught, it departs with a rush through the first open induction port which is handy, washing the already under-lubricated cylinder walls in the process. Once the engine is warm, however, the cylinder walls receive their proper quota of oil and, with vaporisation conditions improved, life for the pistons becomes much more bearable.

Oil Dilution

The Worth system of oil dilution, by reducing the viscosity of the oil, assists starting through making the engine easier to turn when cold, and promotes the initial lubrication. This means that the engine can be opened up much sooner when it is cold, and so cuts down the period of "agony" and washing.

The Bristol family of engines have for some years incorporated the high initial oil-pressure system which allows their engines to be opened up to take-off conditions with oil temperatures as low as 5 deg. C., but so far as testing new engines, which, of course, have rather closer limits than fully run-in ones, it is advisable to reach a higher temperature before opening up. Two other factors deserving special consideration are the junk-heads of sleeve-valve engines and the amount of overload which the oil-pressure gauge can endure without becoming permanently strained and, therefore, inaccurate. Irrespective of oil temperature, the junk-heads of an air-cooled engine should be warmed to 100 deg. C. so that they may complete their initial expansion gradually before full power is applied.

Oil-pressure gauges, which are mostly supplied with the 0-150 lb. scale, are supposed to withstand 100 per cent. overload without damage, but this is rather a severe test, and in practice it is unwise to expect every production instrument to be unharmed by such a load. In fact, it is wise to try to avoid running up the engine at such a low temperature that 150 lb. is exceeded at all. This only means waiting for the temperature to rise another 10 degrees or so.

Hot-air Intakes

Most engines now are provided with a hot- and cold-air intake, which may be worked in one of three ways—hand controlled entirely by pilot, hand control which can be used to override an automatic one, or fully automatic. With either of the first two types the pilot can use the hot-air intake to speed up the warming-up period. Besides supplying the carburettor with warm air, the hot-air intake usually has the characteristic of being more restricted than the cold one, and this, as well as the temperature rise, allows more throttle to be used for any given warming-up revs, which also tends to reduce the period as a whole.

Air-cooled engines can be further assisted in the initial warming-up period by closing the gills.

It may be well to add a note of caution concerning warming up on hot-air intake and with gills closed. These practices are all very well for the test pilot who is fully conversant with the technique of engine handling, but care should be taken in advising this procedure to all and sundry. It is better that the engines should endure another minute's agony in warming up than that P/O Prune should suffer the consequences of taking-off, in a forgetful moment, with gills shut and carburettor on hot-air intake.

The optimum warming-up revs vary considerably according to the type of engine, some being as low as 1,000 to 1,200 r.p.m., and others as high as 2,000 r.p.m. The exact speed is always declared by the engine maker, and is designed to form the best compromise between so fast a speed that there would be insufficient oil splashed on to the cylinder walls to keep them lubricated, and so slow a speed that plug-fouling and washing would be accentuated.

AVIATION CHAIR IN GLASGOW UNIVERSITY SUGGESTED

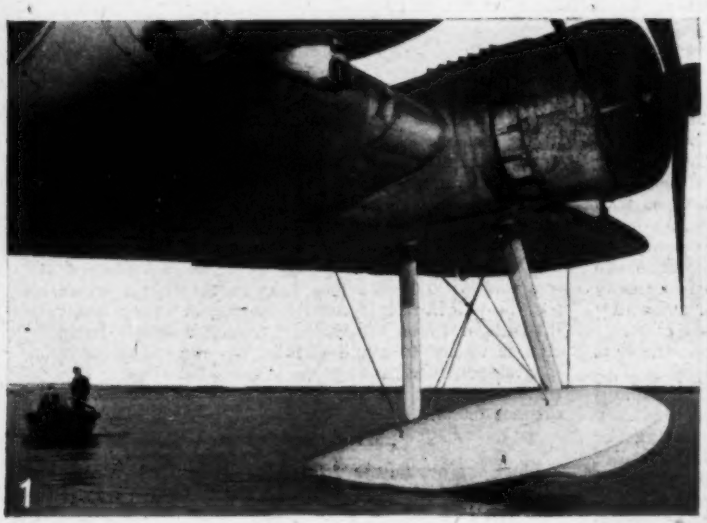
THE establishment of a Chair of Aviation at Glasgow University was advocated by Sir P. J. Dollan recently when he addressed the students in his capacity as president of the University Dialectic Society.

The West of Scotland, he said, was bound to become a great centre for international aviation after the war, and there would be plenty of opportunities for young engineers to develop their talents in design, construction and equipment, and to become experts in navigation and other services. The university should take the lead in this training, and he suggested that shipbuilding and engineering firms and others interested should subscribe at least £50,000 to endow a Chair of Aviation at the University.

Glasgow would be given the opportunity to become as famous in the design and construction of aircraft as it now was in shipbuilding and engineering. These two industries would find aviation a useful supplement and should prepare for this development by helping the university to organise the training. Glasgow University would become the first with a department for aviation which could work in co-operation with the engineering and shipbuilding sections with which it would have much in common.

Flight Engineer . . . .

Looking After a Sunderland's Engines on Patrol and at Rest : Engine Expert who Makes the Boat His Home



1. A power dinghy brings the flight engineer out to the Sunderland.
2. Climbing aboard with his kitbag through the entrance hatch.

THE Short Sunderland flying boats which have done such excellent work for Coastal Command carry a crew of eleven men. Not the least important member of this crew is the trained flight engineer who is directly responsible to the captain of the aircraft for the running of the engines. In addition to his ordinary training and

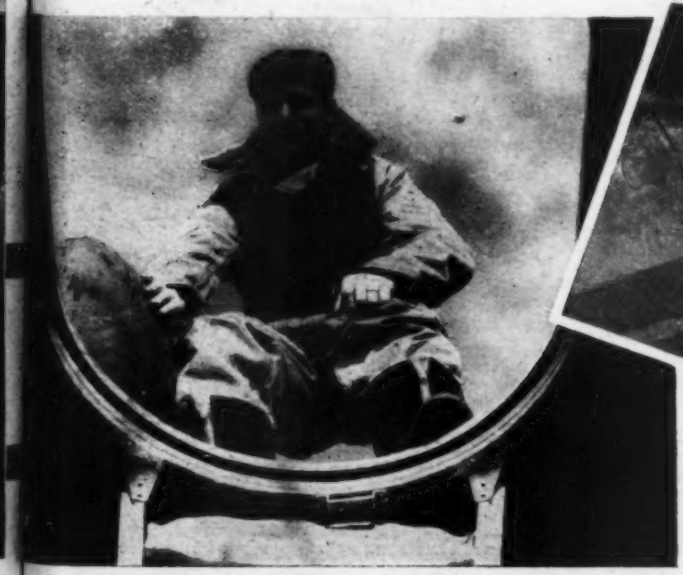
5. Checking up the pilot's throttle controls for back lash.
6. Tea at eleven with the rigger/air-gunner whose work is to look after the airframe.

A Sunderland carries four bunks, and at least two of the crew must remain aboard all the time the aircraft is afloat. Note the camera and mounting over the porthole.

mulated experience, he has attended special courses at both tols and Shorts in order that he might be quite familiar with Pegasus engines and their controls.

o simplify the first pilot's work on these four-engined flying ats, all the engine instruments such as the revolution counters, thermometers and pressure gauges, boost gauges, fuel cocks d cooling gill controls come to a panel in the centre section the rear of the main control cockpit. It is the flight gineer's job during the long 12-hour patrols continually to eck the functioning of all the power plants. Only master ntrols and instruments are fitted in the pilot's cockpit.

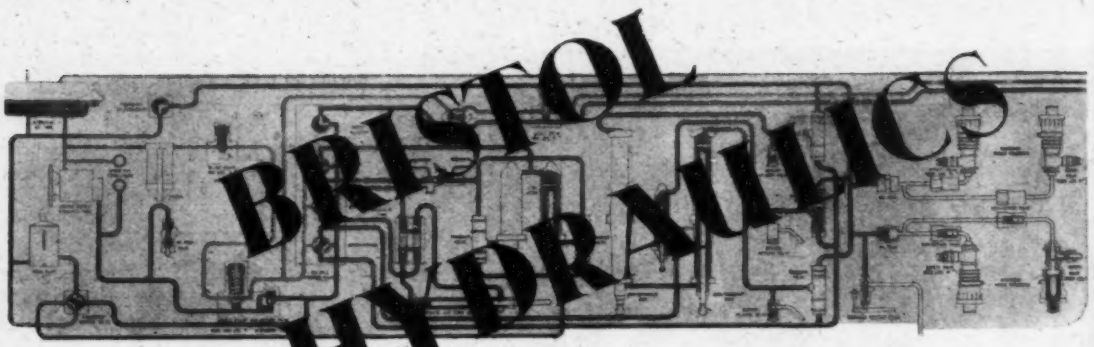
When the machine is at rest it is the flight engineer's job check over all the engine controls and supervise any main- nance work carried out by the ground staff on the engines. o "passengers" are allowed in Royal Air Force machines and eryone in the crew must be able to pull his weight in the ent of a scrap developing. The flight engineer, therefore, is o a trained air-gunner and is capable of handling any of the wer-operated turrets



4. Signalling ashore with an Aldis lamp for the dinghy to pick up some spares.

7. Entrance and exit for engine inspection is through the astro-hatch.

8. Lending the maintenance staff a hand in overhauling one of the starboard Pegasus engines.



BRISTOL HYDRAULICS

A Simple "Open-System" Method of Operating Undercarriages, Tail Wheels, Bomb Doors, Wing Flaps and Gun Turrets

FLUID pressure is a convenient way of transmitting power to remote parts of the aircraft with a minimum loss of efficiency. By using malleable pipe lines, these can be bent to suit the contours of the aircraft, etc., avoiding the necessity of introducing complicated mechanical parts.

Since oil is the fluid normally used in "hydraulic" systems in aircraft, all components will be automatically lubricated, minimising wear and tear and consequently reducing the amount of maintenance work necessary.

The Bristol hydraulic system was first developed in 1935, by a special research department of the Bristol Aeroplane Company, Ltd., and is used to control wing flaps, undercarriage, bomb door locks, and the Bristol power-operated gun turret, which has been so widely adopted.

It was designed to provide a simple method of remote control for aircraft components, which was reliable and light in weight, combined with the advantages of flexibility of control, a quick smooth reversal of motion without shock; a useful "slip" for overloads or obstruction; and a convenient location of transmission members, while the use of relief or control valves provides a safeguard against overloading. The outstanding feature of the Bristol hydraulic system lies in its simplicity and freedom from complicated components, the entire system being easily understood by those responsible for its operation and maintenance.

In the Bristol system no "special fluid" is required, the fluid used being anti-freezing oil which is readily obtainable throughout the R.A.F., and is therefore a "common store."

By using either engine or hand-operated pumps, capable of supplying fluid under suitable pressure to any number of components through a system of pipes and simple control valves, heavy components can be operated with a minimum amount of power or effort.

For example, to transmit a pressure of 1,200 lb. per sq. in. by means of a hand pump, as is possible in Bristol aircraft, the piston area in the hand pump is less than one square inch, whilst the handle gives additional leverage.

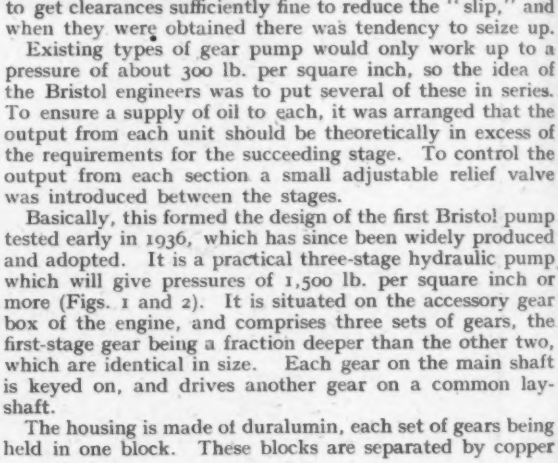
Bristol Hydraulic Pumps

Before the Bristol hydraulic system could be developed it was necessary to design an engine-driven pump capable of supplying oil at suitable pressures. Bristol engineers, realising the disadvantages of plunger type pumps—such as violent fluctuations of pressure which cause breakages—decided that either the vane type had to be employed, with its considerable limitations for high pressure, or else the gear pump, the faults of which were that it was difficult to get clearances sufficiently fine to reduce the "slip," and when they were obtained there was tendency to seize up.

Existing types of gear pump would only work up to a pressure of about 300 lb. per square inch, so the idea of the Bristol engineers was to put several of these in series. To ensure a supply of oil to each, it was arranged that the output from each unit should be theoretically in excess of the requirements for the succeeding stage. To control the output from each section a small adjustable relief valve was introduced between the stages.

Basically, this formed the design of the first Bristol pump tested early in 1936, which has since been widely produced and adopted. It is a practical three-stage hydraulic pump which will give pressures of 1,500 lb. per square inch or more (Figs. 1 and 2). It is situated on the accessory gear box of the engine, and comprises three sets of gears, the first-stage gear being a fraction deeper than the other two, which are identical in size. Each gear on the main shaft is keyed on, and drives another gear on a common layshaft.

The housing is made of duralumin, each set of gears being held in one block. These blocks are separated by copper



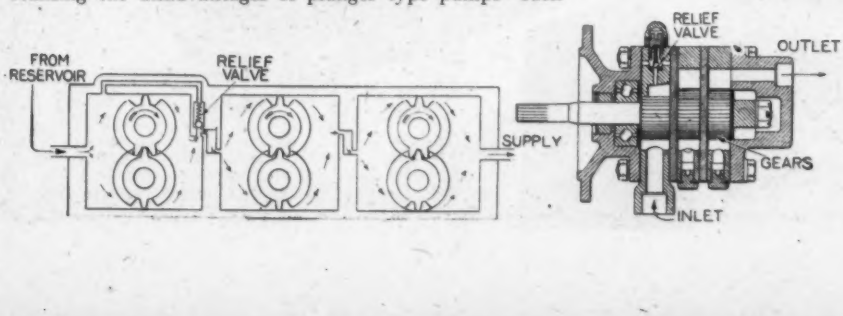
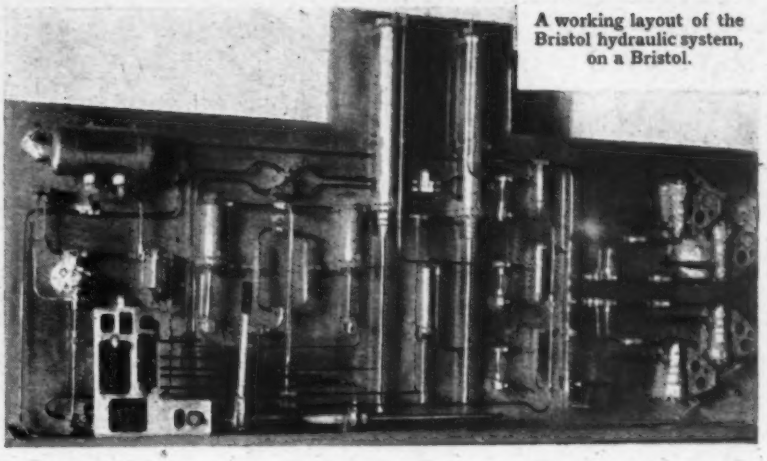


Fig. 1 (above) is the Bristol hydraulic pump, which was tested early in 1936. The pump is of the three-stage type, as shown in section in Fig. 2 (left.) The first stage is slightly deeper than the other two.

BRISTOL HYDRAULICS

gaskets suitably drilled to allow oil to pass from one stage to the next. Bearing races are provided at each end of the engine-driven shaft. Oil is forced by the gears around the face of the housing, i.e., between the gear teeth and the housing wall, clearance being very small. A relief valve of the usual spring-and-ball type is provided between the first and second stages to relieve excess pressure, the return leading back to the inlet side of the stage. Each pump is capable of delivering 2¾ gallons of oil per minute at normal engine speed of 2,400 r.p.m. This pump requires no servicing and should not be touched.



A working layout of the Bristol hydraulic system, on a Bristol.

Layout of System

A typical layout of the Bristol hydraulic system is shown in the heading block.

The engine-driven Bristol three-stage pump circulates oil in a pipe circuit, the unions of which are of the simplest kind: the belled end of the pipe fitting directly over the shaped union, there are no "olives" which are so easily "put in the wrong way," or even omitted altogether.

Placed in appropriate positions in the system are control valves to direct the oil; relief valves to relieve excess pressure; and the operating jacks for the various components. The circuit illustrated includes a double hydraulic lock, the function of which is to control the movement of the bomb doors.

The Bristol hydraulic system is claimed to be unique in that it is operated as an *open system*, thus obviating the use of a "recuperator" or supplementary air pressure which is necessary with a closed system, involving, as it does, the use of auxiliary pumps, operated either by hand or by motor. This not only involves considerably increased maintenance, but a further increase in weight, which, of course, is undesirable in aircraft equipment.

Each moving component, i.e., each undercarriage, tail wheel, pair of flaps and bomb doors, is operated by its particular hydraulic jack. These jacks, though varying in size, are practically identical in construction, consisting of a hiduminium cylinder, having an inlet port at each end; a piston having rubberised fabric glands or washers; and a piston rod. Where the piston rod passes out of the end of the cylinder, gland packing rings are fitted to prevent oil leakage.

By means of the control valve, a multiple unit of simple rotary valves, the oil circulating under pressure from the pump can be directed to either end of the jack, so moving the piston in the direction required, and thus moving the unit, i.e., undercarriage, etc., to which it is attached.

The Multiple Control Valve

The multiple control valve (Fig. 3) consists of a series of four rotary valves in one compact unit. It is a duralumin casting and provides housing for the valves, drilled to provide oilways and machined to take the rotating plugs. It will be seen from the diagram that the two main oilways are the supply and return, the supply being led to the various valves and, in the case of the undercarriage, flaps, and bomb doors, to the required end of the jack according to the position of the valve.

These three valves are identical; but the fourth, i.e., the selector valve, is slightly different, having two right angle ducts, the bore of one being much smaller than the other.

The operation of this valve is as follows: When the selector knob is in the "In" position, the large right angle duct in the valve connects up on the supply circuit to return via the gun turret and so relieves the system of pressure. When the selector knob is in the *midway* position, the small right-angle duct connects the supply circuit to "Return," thus permitting sufficient flow to operate the bomb doors. With the selector knob in the *out* position, the supply is entirely cut off from the return circuit and turret, and all pressure is retained to operate the undercarriage, flaps, and bomb doors. It will be seen that the *midway* position would only be used when it is necessary to operate the turret and bomb doors simultaneously. The function of the undercarriage, flaps, and bomb door rotary valves can easily be seen in the diagram.

Pilot's Hydraulic Control Panel

These valves are operated from the pilot's hydraulic control panel. The controls consist of three levers, covering undercarriages, flaps, and bomb doors; and two push knobs operating respectively the *selector* and *emergency control valves*. Moving the undercarriage control lever up or down results in a corresponding movement of the undercarriage. The flap control lever is used in the same manner, except that by placing it in the mid position provided, the movement of the flaps can be arrested at any degree of their travel. The bomb door control lever opens and closes the bomb doors.

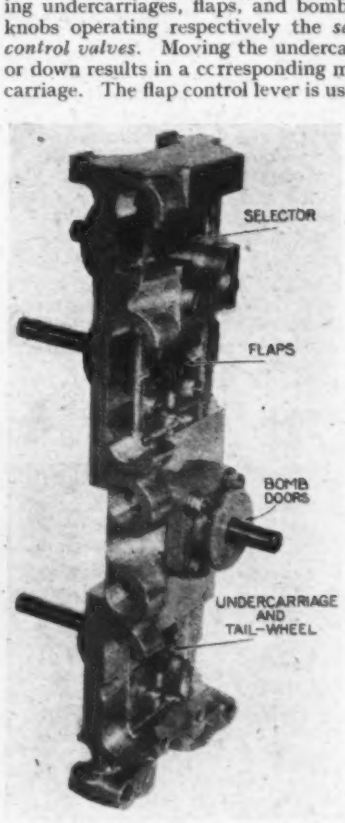


Fig. 3. The Bristol multiple control valve comprises four rotary valves in a unit.

Supply and Return

It must be clearly understood that the whole system is *full* of oil, and it is the circulation of the oil that constitutes the working of the system; e.g., if the oil is directed to the top of the jack it will force the piston to the bottom. This oil circuit is known as the "High Pressure," or *Supply*; and the moving piston will displace the oil below it; this is known as the "Low Pressure," or *Return*. It will be seen that the pipes leading to the top

BRISTOL HYDRAULICS

and bottom of the jacks are either supply or return according to the direction of the oil supply.

To keep the system full of oil, or "topped-up," a reservoir is placed at the highest point in the system; this reservoir is filled to the level of the filler cap, the position of which ensures air space being left. A vent pipe is also fitted.

Double Relief and Non-return Valve

When the piston in any jack has reached the end of its travel, pressure will immediately be built up in the supply line; the excess in the system is relieved by a spring-loaded poppet type main relief valve which opens at a pressure of 1,200 lb. per square inch and by-passes oil from the high pressure line to the low. Combined with the main relief valve, forming a neat and compact unit, is a secondary relief valve operating at 1,300 lb. per square inch, and a ball type non-return valve. (Fig. 4.)

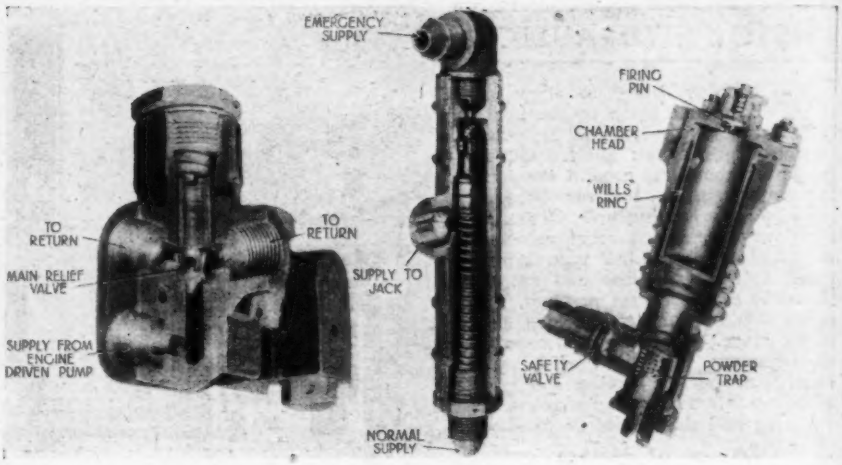


Fig. 4 (left) shows the Bristol double relief and non-return valve. One of the transfer valves is shown in the centre (Fig. 5), and on the right (Fig. 6) is one of the cartridge firing chambers.

The Transfer Valves

There are five of these components in the system, one fitted adjacent to each jack, i.e., undercarriage, flaps, and tail wheel; and they are situated in the supply line that provides pressure to operate the undercarriage, flaps, and tail wheel downwards; that is to say, in the pipe line leading to the top of the undercarriage and tail wheel jacks and to the bottom of the flap jacks, because in the case of the flaps—owing to the method of attachment—when the flaps move down, the piston in the jack moves up.

When the emergency systems are brought into use, the transfer valves close off the normal supply and open the emergency supply to the jacks; and conversely, when the normal supply is in use, the emergency supply is closed off.

The transfer valve has three pipe connections, one at each end and one in the centre, the normal supply entering the valve at the lower connection and the emergency supply at the top, while the centre connection leads to the jacks. The movement of a spring-loaded shuttle determines which supply enters the jack.

Fig. 5 shows the plunger in the normal position, i.e., plunger or shuttle held up by the spring and sealing off the emergency line; but, when pressure is applied to the emergency line, the shuttle is forced down, overcoming the resistance of the spring until it meets and seals off the normal supply. Pressure from the emergency line is now free to enter the jack.

Emergency and Servicing Controls

A double-acting hand pump is fitted adjacent to the pilot's right hand and is used for servicing or emergency. Oil is drawn from the return line and delivered to the selector valve; the ball type non-return valve prevents oil from the hand pump entering the engine-driven pump line, while excess pressure is relieved through the secondary relief valve.

From the diagram it will be seen that the emergency undercarriage and tail wheel lowering is by means of a cartridge firing system. There are four gas-producing cartridges, each contained in a cartridge firing chamber. They are inter-connected and all four are fired simultaneously, either mechanically or electrically, from the pilot's cockpit. The hand pump has no part in this system. (Fig. 6.)

The gas passes from the chamber, through a non-return valve adjacent to each chamber to the oil-sealing valves, and thence to the three transfer valves serving undercarriages and tail wheel (Fig. 7.)

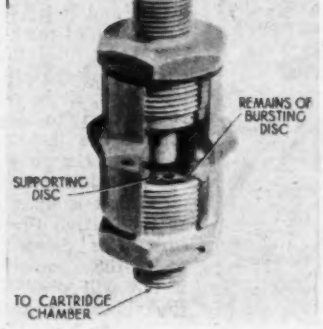


Fig. 7. One of the three transfer valves which serve the undercarriage units and tail wheel.

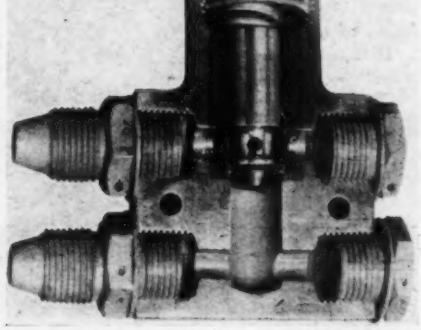


Fig. 8. Pressure is reduced from 1,200 lb. per sq. in. to 600 lb. per sq. in. by the relief valve shown above.

By-pass and Relief Valves Reduce Pressure to 600 Pounds

When the aircraft is on the ground with the engines running and the main selector in the *out* position, the pressure in the system is reduced from 1,200 lb. per square inch to 600 lb. per square inch by means of a by-pass valve and a 600 lb. per square inch relief valve. (Fig. 8.)

The by-pass valve, of the ordinary ball type, is situated in the main supply line between the engine-driven pump and the double relief and non-return valve, and is operated by a rod attached to the outboard port oleo leg. (Fig. 9.)

The outlet side of this valve is connected by a short length of piping to the inlet side of the 600 lb. per square inch relief valve, which is situated in the main return line adjacent to the filter This valve is a spring-loaded poppet valve of similar construction

BRISTOL HYDRAULICS

to the main relief valve. On the weight of the aircraft being taken by the oleo leg, it telescopes and the rod attached moves upwards and, through the medium of a lever, presses against a spring-loaded plunger in the by-pass valve, which displaces the ball from its seating, thus permitting fluid to pass to the 600 lb. per sq. in. relief valve which, opening at that pressure, passes the fluid to the return line.

On the aircraft becoming airborne the oleo leg extends, the by-pass valve becoming inoperative. Pressure will then be relieved at 1,200 lb. per square inch until the selector is placed in the *in* position.

Double Hydraulic Lock

The double hydraulic lock prevents any movement of the bomb doors unless hydraulic pressure is applied, such as might occur owing to their weight when closed, or to airflow or to centrifugal force when open. It is situated in the system between the bomb-door control valve and the bomb-door operating jack. When hydraulic pressure is not applied, two spring-loaded poppet valves prevent displacement of oil from the jack, thereby preventing movement of the jack piston. (Fig. 10.)

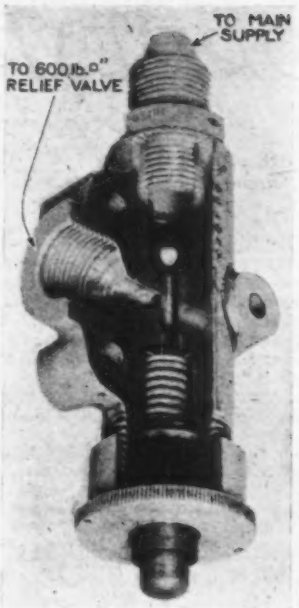
Choke Valve

To prevent too rapid upward movement of the flaps, necessary for aerodynamic reasons, a choke valve is situated in the return circuit from the flap jack.

This is of the ball non-return type. The ball is displaced from its seating by the returning fluid as the flap goes down, but, on the fluid returning in the opposite direction as the flap goes up, the ball is forced on to its seating and the fluid takes a path through a by-pass pipe of small bore, thus restricting the rate of movement.

All oil in the system returning to the pump or reservoir is filtered by its passage through a fine mesh gauze filter, which is readily accessible for cleaning.

The Bristol hydraulic system has proved efficient in use and easy of maintenance, contributing its share to the success of Bristol aircraft in all fields of this war, and, therefore, to the continuing success of the R.A.F. in its supremacy over the enemy.



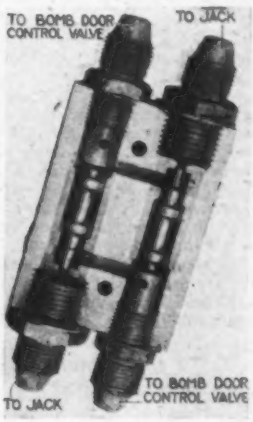


Fig. 9 (left). The by-pass valve is operated by a rod from the outboard port oleo leg.
Fig. 10 (below). When hydraulic pressure is not applied, two spring-loaded poppet valves prevent displacement of oil from the jack.

ORLEBAR'S NEW POST

Deputy Chief of Combined Operations Under Lord Louis Mountbatten

IT is not extremely common for a man who has won fame by his skill as a pilot to attain to high administrative command. Very few record-makers in the Air Force have done so, and so it is particularly notable that Air Vice-Marshal Orlebar, A.F.C., who once established a world's speed record over the three kilometre course prescribed by the F.A.I., should now be appointed Deputy Chief of Combined Operations. Orlebar twice commanded the R.A.F. High Speed Flight, in 1929 and in 1931, and though he did not take part himself in either Schneider contest, he always personally tested each racing seaplane when it was delivered by the manufacturers to the Flight. His skill as a pilot, however, was always a secondary consideration. He was an ideal commander and organiser, who won without effort the enthusiastic loyalty of the men whom he commanded. He has also graduated at the Staff College at Andover, where the doctrines of war are studied and taught, and it may also be remembered that in the former world war he served for a while in an infantry regiment. This record, quite apart from his capabilities as a pilot, should make him a particularly suitable assistant to Vice-Admiral (and Lieut. General and Air Marshal) Lord Louis Mountbatten in organising the Combined Operations which, we all expect, will play a great part in the coming invasion of the Continent, whether that comes from the north or the south.

A DUNCAN DAVIS SIGNAL

DURING a war, when old friends and fellow workers are apt to be scattered far and wide, it is always difficult to keep track of everyone. In clubs and at work one may hear odd scraps of news, but these are apt to be scanty and not always too reliable. Capt. Duncan Davis finds that he has lost touch with many of his old friends and members of the Brooklands, Northamptonshire and South Coast Flying Clubs, with whom he is anxious to re-establish contact. He has asked *Flight* to tell them that he is staying at the King's Private Hotel, Clifton Drive North, St. Annes-on-Sea, and will be glad to hear from them.

GYRO CINECURE

FEW pieces of apparatus puzzle the student or pupil more than the automatic pilot. Realising this, Mr. Vivian Holman, manager of the aeronautical department of the Sperry Gyroscope Co., Ltd., brought back with him from a recent trip to the United States a series of instructional films prepared by the American parent company, mainly for the American Forces.

These films, some of which were shown to officers of the R.A.F., Fleet Air Arm and others at a private showing recently, explain very clearly not only how the gyro operates in such instruments as the Sperry Artificial Horizon and the Automatic Pilot, but the adjustments and settings which the pilot has to make in order to make the aircraft execute the desired manœuvre. Flat turns, banked turns, climbing turns and spiral descents all come within the scope of the automatic pilot, and are shown suitably simplified for the beginners for whom the films are intended.

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CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

BEST TYPES OF AIRCRAFT

Barracuda's Unknown Virtues

IN the March 4th issue of *Flight* your correspondent "Ex-R.F.C." gives his choice of the best military aircraft in each of numerous specialised classes.

The first point is how does he know that the Fairey Barracuda is the world's best naval torpedo bomber? Surely he is basing his "knowledge" on recent Press reports, as it is still an untried type—at least as far as the general public are concerned. I would suggest substituting the Douglas Devastator (TBD-1) or the Grumman Avenger (TBF-1) which the Japanese Navy have reason to believe are good aircraft.

Secondly, I would substitute the Bristol Beaufort for the Handley Page Hampden (or even the Wellington) as a land-based torpedo-bomber.

It is difficult to say whether the North American Mitchell (B-25) is superior to the Martin Marauder (B-26) or to the Lockheed-Vega Ventura (B-34), as they are all excellent medium bombers, with exceedingly good defensive armament.

"R.N.V.R. (A.)."

Interceptor or Single-seater Fighter?

IN your issue dated March 4th, "Ex-R.F.C." has tabulated a list of what he considers the leading aircraft in each category, and asks: "What do your readers think of my selections?" I agree with him except in three cases. Here they are:

(*a*) The difference between a single-seater fighter and an interceptor. The Hawker Typhoon *is* a single-seater fighter and is produced to supersede in fighting duties the Spitfire and Hurricane as they, in their turn, superseded the Hawker Fury. I therefore consider the top category, "single-seater fighter," should be omitted.

(*b*) This is the claim that inspired me to write this letter. The Mitchell is hardly even comparable with the Dornier Do 217F, particularly in armament and also in performance. As regards armament, the Mitchell appears to be very inadequately equipped. The Douglas Boston III has a better performance and a very much better armament than the Mitchell.

(*c*) Surely the Seafire and the Sea Hurricane are very much better in every way than the Vought-Sikorsky Corsair, the maximum speed of which is reported to be only 370 m.p.h., and the weight must be comparable with that of the Republic Thunderbolt (13,000 lb.). I am convinced that the Seafire is far superior in every way as a fighting aircraft, not only in armament and speed, but, probably even more important, it is easy to fly and therefore easy to fight in.

I would like to see "Lancaster II" as the heavy bomber, as I consider the Stirling superior to the Lancaster I.

G. E. D. ROSS.

TRAINING THE AIRCRAFT ENGINEER

Varsity Students "Brought Up on Steam"

I HAVE just been reading an article by Capt. J. L. Pritchard on "Training the Aircraft Engineer" in the March 11th issue of *Flight*. The secretary of the Royal Aeronautical Society makes the following points with which, as a university student, I heartily agree.

". . . a boy who wishes to be a designer . . . would be trained in all workshop processes and methods concurrently with being taught the fundamental theory of engineering. On the highest rung he will have gone to the university and would get his B.Sc. During the whole of his training he would have theory and practice side by side.

"At the university . . . I see no reason why practical construction, design and research, as put forward by the industry, should not be carried out on behalf of the industry as a whole. During the whole of his training to be an aircraft engineer the trainee would live in the atmosphere of his future job."

Since the universities of this country have no special provisions for aeronautical engineering training, and since our work is largely academic, it is not a little disturbing to contemplate just how competent we are going to be when we have taken our B.Sc. and start out on aeronautical engineering as a career.

The war makes it essential that on leaving a university and entering into industry or the Armed Forces in a technical capacity the student should be fully acquainted with the atmosphere of his job and have a sound knowledge of the men and machines with which he will work.

For the student who wishes to design or build aircraft when he has left his training here it is somewhat ridiculous that he should be brought up on steam engines, surveying and other subjects which, although useful in themselves, are apt to discourage him when he thinks of those who have closer contact with aircraft—in the factories, for example. A general education in all branches of engineering is useful, but why is aviation so sadly neglected?

A further point. I wonder why Capt. Pritchard mentions the question of whether a boy of sixteen would be sure of the type of career he wished to take up? As far as aviation is concerned, whether it is flying or engineering, interest is usually excited at an earlier age.

From my own experience I can say that I started making models at the age of thirteen. I began to take an interest in aviation itself soon afterwards and, despite a remark on my school report at the age of fourteen, "overmuch aircraft at present," my enthusiasm for flying machines steadily increased. At school my interests were discouraged (the comment on my fourth form report inferred that I was suffering from a boyish craze), and when I entered this university I found the fascinating subject of aeronautical engineering almost entirely neglected. I have these suggestions to make:

(1) Aeronautics, as the most important and attractive branch of engineering, should be introduced into the university syllabus.

(2) We should have more opportunities to study the practical side of our future job.

(3) Aviation should be introduced (as a branch of maths., history, art, etc.) in schools by encouraging aero modelling, studying the development of aircraft, and using simple examples of theory of flight in the higher certificate applied maths. syllabus.

It is good to know that the education of the aircraft engineer is receiving the attention of the aircraft world through the medium of your journal. Let's hope something will be done—soon.

S. W. G.

Little Encouragement for Good Scheme

I READ with interest the article by Capt. J. Laurence Pritchard, in your issue of March 11th, on "Training the Aircraft Engineer."

About 1934 the University College, Hull, in conjunction with the Municipal Technical College and Blackburn Aircraft, Ltd., made available a diploma course in aeronautics.

The conditions for the award of the diploma are as follows: (1) The student must have spent two years in the workshops of an approved aircraft constructor. (2) He must pass the intermediate and final examinations of a full-time day course in aircraft engineering, which extends over a further two years. During these two years the student roughly divides his time between the University College and the Technical College. At the Technical College he attends lectures on Theory of Machines, Heat Engines, Aircraft Design, Hydraulics, Strength of Materials, etc., and he is also able to carry out wind tunnel and mechanical tests in the laboratories.

At the University College, lectures are given on Mathematics (pure and applied), Fluid Motion, Physics, Elasticity, etc. (3) The student must spend not less than nine months in the drawing office of an approved firm of aircraft constructors.

Blackburn Aircraft have generously made a practice of giving financial assistance to four of their most promising apprentices each year so that they may attend the University College for the two-year period. It is a condition that before beginning the University College course the student apprentice shall have been awarded the Ordinary National Certificate in Mechanical Engineering, which he normally covers by evening classes during his period in the workshops.

Actually, it has been found in practice that a majority of students have also passed an examination of general education such as matriculation, though this is not considered essential.

The Diploma in Aeronautics Course seems to me to be a very good start towards the ideal system of aircraft engineering education, as proposed by Capt. Pritchard. However, it has received very little encouragement to date, and only the rare

CORRESPONDENCE

honour of a Diploma given with the special mark of distinction will exempt the holder from the Associate Fellowship examination of the Royal Aeronautical Society.

Blackburn Aircraft apprentices have now discovered that it is far easier for them to continue their evening classes for a further two years after reaching the Ordinary National Certificate standard. If they are then successful in the examination for the Higher National Certificate they are exempted from the Associate Fellowship examination and also have a qualification which is widely recognised.

May I ask whether it is of any value to discuss far-reaching schemes for aircraft engineering education when the people at present in authority, who had a chance to develop good schemes, such as the Diploma in Aeronautics, remain disinterested?

"CAMSHAFT O.K."

INTERNATIONAL AIR POLICE

Vital for the Assurance of Peace

THE article by "Ajax" on "An International Air Police Force," which you published on January 28th, 1943, is as clear-minded an exposition of that vital principle for the assurance of perpetual peace as one might hope to see. More and more the sheer necessity of this sole method of abolishing international strife is forcing itself on the attention of earnest thinkers.

For full acceptance at the peace table, however, it is necessary that it should become a fixed principle in men's minds even while the conflict rages, for otherwise, presented suddenly, it runs a risk of being shelved or stripped of its essentials.

Such articles as that of "Ajax," therefore, are of utmost value, particularly at this moment when the tide of war is changing in our favour. Such high-minded policy deserves, in American parlance, to be "plugged."

L. E. O. CHARLTON,
(Air Commodore (ret.), R.A.F.).

EX-R.A.F. PILOTS

Difficulty Over Flying Tests

RE the letter of T. R. Thomas, Secretary, Air Registration Board, in the March 11th issue of *Flight*, on the subject of ex-R.A.F. pilots and the obtaining of a "B" licence.

I have been trying to get a "B" licence myself for some considerable time, and have been given permission to sit for it. After reading Air Navigation Directions 13, 1936, Para. 99, and seeing that I, after being R.A.F. trained, only had to take the sections (d) and (e), as stated, I wrote to Air Ministry at Bristol to see if this was correct.

I received a reply to the effect that if I had flown types in the R.A.F. equivalent to commercial types I would only need to take the technical examination as laid down in the second half of A.N.D. 13, Para. 99. If these types of aircraft had not been flown, I would have to take a flying test as laid down in the first half of Para. 99, plus the full examination. Owing to the trouble at the present time, the Department could not supply an aircraft on which to carry out the tests.

If this is the case all around, I consider it only fair that all pilots should know about it before they go buying books and really wasting hours of reading for an examination which they will not be able to pass because of this hitch. A.N.D. 13, 1936, should be amended to state this fact.

"DOUBLE D.F.C."

Book Reviews

East of Malta, West of Suez. The Admiralty Account of the Naval War in the Eastern Mediterranean, September, 1939, to March, 1941. Prepared by the Ministry of Information for publication by H.M. Stationery Office. 1s. net.

COMPARISONS are proverbially odious, and it would be ungracious to suggest which episode of the war to date makes the most brave and dramatic story. None, however, will deny that the tale of the Mediterranean Fleet is in the front line, whatever the criterion may be. This official account of its doings is the second official Admiralty publication of the war, and it yields to none of the other official recitals in matter and in treatment. It is indeed a thriller, and should undoubtedly become a best seller. The excellent photographs and plans which illustrate it add much to its attraction.

Probably every reader has his or her own pet Service, and, of course, *Flight* is chiefly concerned with the air, whether the actors in that element belong to the R.A.F. or the Fleet Air Arm. Still, no British reader can help a thrill of pride when he reads of that sea fight in July, 1940, when H.M.S. *Warspite* scored a hit on the Italian battleship *Cesare* at the enormous range of 26,000 yards—fifteen miles. But we must confine our comments to the air side of the operations.

In May, 1940, the carrier H.M.S. *Eagle* steamed from the Far East to join the Fleet at Alexandria. She was old and slow, and had only two squadrons of Swordfish in her hangars, but later acquired four Gladiators. There were no fighter pilots in her company, but the Commander (Flying) had once been a fighter pilot, so he went up alone to defend the Fleet, and contrived to do it. Later he trained two Swordfish pilots to fly Gladiators and to fight in them, and the three shot down eleven enemy aircraft and saved the Fleet from major damage. The *Eagle* has hardly received all the credit which is her due. She had received damage from near misses which prevented her from being present at Taranto, but her Swordfish were taken on board the *Illustrious* for that astonishing feat of arms. Later, one of her Squadrons, No. 815, was divided between Greece and Crete, and when Matapan was being fought each section had one serviceable Swordfish and one torpedo left; both flew out to take part in the battle. The new carriers, *Illustrious* and *Formidable*, proved of major importance. The brave deeds recounted are almost innumerable, and we advise all our readers to get the book for themselves.

Navigation

TEXT books on the all-important subject of how to find one's way about in the limitless sky continue to pour forth in spite of the paper shortage. They vary from elementary outlines to complete studies, including the special branch of astro-navigation, but since it is all one science they vary only in range and treatment; much overlapping is therefore inevitable. Here is a summary of a few of the more recent additions to the ever-growing list.

"A First Course in Air Navigation." By F. F. Crossley Macmillan. 2s. 6d.; "Navigation for Air Crews." By John E. C. Gliddon and Edward C. Hedges. University of London Press. 2s.; and "Navigation." By J. C. Kingsland and D.W. Seager. Oxford University Press. 2s. 6d.—These three will suit the beginner. They start with the form of the earth, explaining longitude and latitude, and pass on via map and chart reading, the magnetic compass, bearings, courses, drift, etc., to a little basic meteorology and dead reckoning. All cover practically the same ground and are equally useful.

"Numerical Examples in Elementary Air Navigation" (Second Edition). By G. K. Clatworthy. Pitman. 3s. 6d.—This book provides progressive exercises in elementary air navigation to enable students to speed up their computation under flying conditions.

"The Complete Air Navigator." By D. C. T. Bennett. Pitman. 15s.—Nothing the student needs to know, by night or day, has been omitted from this comprehensive treatise. It has sections on summarised mathematics covering logarithms and trigonometry, map and chart projections, aircraft instruments, direction-finding wireless and signals, dead reckoning, astro-navigation and meteorology, the tides, and the chronometer and sextants. For those who already have a grounding in the subject it should prove very helpful.

"Astronomical Navigation." By W. M. Smart. Longmans. 5s.—Beginning with a chapter on fundamental geometrical principles, this is intended to give the reader a sufficient knowledge of the astronomical foundations of the subject and a detailed discussion of present-day methods.

SERVICE AVIATION

BARRAGE BALLOON BARGE : The "Norman Wade," one of the many balloon-carrying barges which help to protect harbours and shipping from low level attacks.

Royal Air Force and Fleet Air Arm News and Announcements

R.A.F. Transport Command

AIR CHIEF MARSHAL SIR FREDERICK BOWHILL, G.B.E., K.C.B., C.M.G., D.S.O., has been appointed Air Officer Commanding-in-Chief, Transport Command.

As A.O.C. in C. Ferry Command, Sir Frederick had his headquarters in Montreal, but the headquarters of the new Transport Command will be in Britain. Sir Frederick, it will be remembered, was previously A.O.C. in C., Coastal Command, for four years from August, 1937.

His earlier appointments included those of Director of Organisation and Staff Duties at the Air Ministry, Air Officer Commanding Fighting Area, Air Defence of Great Britain and Air Member for Personnel on the Air Council.

He took up flying early, being appointed Flying Officer in the R.F.C. (Naval Wing) in 1913. During the last war he served with the R.N.A.S. and R.A.F. at home and overseas, his commands including the air wing with the military forces in East Africa and a wing in the Mediterranean.

Awards

Middle East Command

THE KING has been graciously pleased to approve the following awards, in recognition of gallantry displayed in flying operations against the enemy.

Distinguished Service Order

Act. Group Capt. H. A. FENTON, D.F.C.—Since being awarded the D.F.C., this officer has successfully led his wing in operation on a number of occasions. During the anxious period of withdrawal from the Western Desert Group Capt. Fenton was responsible for the general administration of the wing and the evacuation of all aircraft, which was successfully and expeditiously executed. By his calm and efficient bearing at critical moments he instilled confidence into all with whom he came in contact. This officer's brilliant leadership and guidance resulted in the great success achieved in November, 1942, culminating in the destruction and capture of a large part of the enemy's equipment.

Wing Cdr. G. D. L. HAYSOM, D.F.C.—Wing Cdr. Haysom has been on operational flying since the commencement of the war. He has destroyed at least six enemy aircraft and has twice been shot down himself. He has led his wing on many fighter bomber and long distance flights.

Air Chief Marshal Sir F. Bowhill, who will take over the new Transport Command.

Act. Wing Cdr. T. M. HORGAN, D.F.C.—This officer has flown on operations continuously since November, 1939. Since being awarded the D.F.C he has participated in sorties against targets in Malta, Greece, Crete, Egypt and the Western Desert, including some unescorted operations in daylight. During the Greece and Crete campaign he showed great courage, skill and determination in pressing home his attacks against heavily defended targets under very adverse weather conditions and over mountainous country. Since July, 1942, he has personally led his squadron on numerous raids, displaying the highest qualities of leadership.

Distinguished Flying Cross

Wing Cdr. G. F. WOOD, O.B.E., No. 70 Sqn.—During the six months this officer has commanded his squadron he has flown on many operations as captain of aircraft. By flying on each mission with a different crew, he has been able to keep in touch with the training and operating ability of the different crews, which has resulted in a high standard of efficiency in the squadron.

Sqn. Ldr. K. MOORE, R.A.A.F., No. 148 Sqn.—This officer, who has served as a flight commander since October, 1942, has set a fine example of perseverance and determination in finding and bombing his target accurately. He has taken part in many raids on Tobruk and has pressed home his attacks at a low altitude.

Act. Sqn. Ldr. J. BARRACLOUGH, A.F.C., No. 209 Sqn.—During recent operations this officer exhibited valuable qualities of keenness and devotion to duty and proved himself a born leader of men. He completed many hours of operational flying, and in the intervening periods supervised the operations of other aircraft.

Flt. Lt. R. HORNBY, R.A.F.V.R., No. 55 Sqn.—Flt Lt. Hornby, in the role of leading navigator and bomb aimer, has taken part in a large number of attacks against enemy targets in the Western Desert and Cyrenaica.

Act. Flt. Lt. R. L. ELLIOT, R.A.F.V.R., No. 70 Sqn.—One night in September, 1942, while attacking Tobruk, one engine of this officer's aircraft failed By skilful airmanship he flew some distance before making a masterly crash landing at

the eastern end of the Qattara Depression. He subsequently displayed fine leadership and resource and succeeded in getting his crew back to our lines on foot two days later. During the battles of El Alamein he displayed exceptional skill in numerous attacks on the enemy.

Act. Flt. Lt. W. R. KOFOED, R.N.Z.A.F., No. 462 (R.A.A.F.) Sqn.—This officer has displayed the highest qualities of leadership and courage in the face of the enemy. His numerous operational sorties include raids on some of the most heavily defended targets. While serving in the United Kingdom he participated in two daylight raids on German warships at Brest. In April, 1942, he took part in two attacks on the enemy naval base at Trondheim, completing his mission from a very low level in the face of the most intense anti-aircraft fire. In the Middle East he has continued to exhibit this high standard of gallantry and devotion to duty, which have been an inspiration to the squadron.

Act. Flt. Lt. P. C. SAWYER, R.A.F.V.R., No. 70 Sqn.—Flt. Lt. Sawyer has taken part in a large number of operational sorties. He has participated in attacks on enemy transport, obtaining hits on vehicles and starting fires. At other times, displaying a fine fighting spirit in his determination to harass the enemy, he has made low level machine gun attacks.

F/O. F. V. CAMPBELL, R.A.A.F., No. 148 Sqn.—As captain of aircraft, this officer has led his crew in a manner worthy of the best traditions, always attacking his objective with determination and gallantry. He has participated in many sorties against Tobruk, in the course of which he has successfully bombed the jetties and shipping in the harbour. On one of these operations, he proceeded with his mission, although the intercommunication of the aircraft was unserviceable. In August, 1942, F/O. Campbell was detailed to drop flares, a task which he accomplished with success, making five runs across the target in spite of concentrated anti-aircraft fire.

F/O. K. S CAMPBELL, R.A.A.F., No. 148 Sqn.—The navigation of F/O. Campbell has always been of an extremely high standard. His astro-navigation when operating in adverse weather has been a fine example of technical skill. He has always shown marked initiative in his methods of attack, resulting in many successes. Twice he has obtained exceptionally fine photographs of Tobruk harbour.

Methods of Attack

F/O. J. CLARK, R.A.A.F., No. 148 Sqn.—This officer has displayed a fine spirit of tenacity and keenness, in the face of hardship and danger. He has exhibited a special aptitude for devising new methods of attack. During numerous attacks on Tobruk he has been successful in bombing jetties and starting fires in the dock area. F/O. Clark has invariably pressed home his mission with determination and coolness, participating in sorties over the battle area, where he has severely damaged enemy motor transport.

F/O. B. H. GRAY, R.N.Z.A.F., No. 70 Sqn.—This officer has participated in many operational sorties, a number of which were against heavily defended targets at Tobruk. One night in November, 1942, after taking part in a bombing raid on enemy tank concentrations he descended to within 50 feet and made a machine gun attack on the enemy's mechanised transport. Two vehicles and a petrol bowser were seen to burst into flames.

F/O. J. D. MACKELLAR, R.A.A.F., No. 148 Sqn.—This officer has participated in a large number of operational sorties in which he has successfully attacked Tobruk many times. On one occasion in August, 1942, despite the presence of dense cloud over the target area, he started a petrol fire near the harbour. He has also made attacks on a number of enemy airfields, transport and tank concentrations with considerable success.

F/O. E. W. SARGENT, R.A.F.V.R., No. 37 Sqn.—This officer has participated in numerous operations, including raids on targets in Crete, Cyrenaica, and enemy occupied territory in the Middle East.

F/O. W. M. STERNS, R.C.A.F., No. 148 Sqn.—F/O. Sterns has flown on operations continuously since July, 1942. He is a highly efficient navigator and bomb aimer who has never failed to reach and bomb his allotted target. In August, 1942, despite adverse weather, he obtained a hit on a petrol installation west of Tobruk harbour, causing a large fire.

F/O. A. WHARTON R.A.A.F., No. 148 Sqn.—F/O. Wharton has taken part in many operational sorties, including a large number of attacks on Tobruk, where on two occasions he was detailed to drop flares. He has also attacked a number of enemy airfields and shipping. On all occasions this officer has pressed home his attacks and often, when returning, has descended to a low level to machine gun enemy transport on the roads.

Lt. J. A. LITHGOW, S.A.A.F., No. 15 (S.A.A.F.) Sqn.—On one occasion in October, 1942, Lt. Lithgow was pilot of a bomber detailed to attack an enemy shipping convoy engaged in the transport of vital supplies to Tobruk. In order to reach his objective Lt. Lithgow had to face intense anti-aircraft fire, and was obliged to pass between two escorting destroyers. His aircraft was repeatedly hit, but undeterred he flew low over the target and bombed a vessel from deck height.

Lt. M. M. YUDELMAN, S.A.A.F., No. 15 (S.A.A.F.) Sqn.—In November, 1942, as navigator of a light bomber, this officer participated in an attack on an enemy convoy carrying vital supplies to Tobruk. In spite of intense anti-aircraft fire to which his aircraft was subjected, Lt. Yudelman delayed as long as possible and reached deck height before releasing his bombs, thus ensuring a hit on the stern of a tanker and setting the vessel on fire.

P/O. A. AUSTIN, R.A.F.V.R.—P/O. Austin has at all times displayed outstanding determination in operations against the enemy. He has participated in many successful sorties on which excellent photographs of the target area have been obtained, often in the face of intense enemy opposition.

P/O. D. W. CAIRNS, R.A.F.V.R., No. 250 Sqn.—P/O. Cairns has been engaged on operational flying for 12 months, taking part in dive bombing and low level attacks and reconnaissance.

W/O. D. NEALE, No. 148 Sqn.—During his operational career W/O. Neale has attacked Tobruk on many occasions. He has frequently made these raids from 1,000 to 1,500 feet, afterwards machine gunning enemy transport in the battle area from 150 feet. On one occasion he illuminated Tobruk harbour, and successfully secured complete details of shipping lying there.

SERVICE AVIATION

Distinguished Flying Medal

Flt. Sgt. R. O. FULLER, R.A.A.F., No. 148 Sqn.—Flt. Sgt. Fuller has operated with skill and enthusiasm for some time prior to the commencement of the present advance of our forces. At his own request, he continued operational flying and has now taken part in many more sorties.

Flt. Sgt. S. B. GRAY-BUCHANAN, R.A.A.F., No. 148 Sqn.—Flt. Sgt. Gray-Buchanan has distinguished himself by his coolness and determination. On two occasions the aircraft, in which he was flying as rear gunner, was attacked by enemy fighters. He obtained hits on an attacking Ju 88 despite the fact that his own aircraft had been struck by the enemy's fire and bullets had passed through his flying clothes.

Flt. Sgt. F. LEVITT, No. 55 Sqn.—This airman has displayed a high standard of gallantry and devotion to duty. Especially during the present intensive operations, his coolness and efficiency in the face of enemy opposition have proved invaluable.

Flt. Sgt. A. W. VAREY, No. 126 Sqn.—Since May, 1942, this pilot has displayed great courage and devotion to duty. He has destroyed at least five enemy aircraft, probably destroyed and damaged many others.

Sgt. C. C. CHAMBERS, No. 148 Sqn.—Sgt. Chambers is a wireless operator of exceptional ability. He possesses an excellent technical knowledge, and on occasions has effected repairs to his wireless apparatus while in the air, and so enabled the mission to be concluded successfully.

Sgt. J. FEATHERSTONE, No. 39 Sqn.—Sgt. Featherstone has taken part in numerous successful attacks on enemy shipping, formerly from England, and latterly from bases in the Middle East. In the later operations he has damaged four enemy aircraft.

Sgt. J. S. HOLLAND, R.C.A.F., No. 70 Sqn.—Throughout his tour of bombing operations this airman has exhibited conspicuous gallantry and determination to reach and attack his target. On one occasion, over Tobruk, his coolness when the front hatch of the aircraft was blown off by intense anti-aircraft fire almost certainly saved the life of the navigator. On another occasion Sgt. Holland was detailed to attack the defences at Tobruk. He successfully bombed two heavy gun positions and a searchlight, and subsequently made five runs just off shore, machine gunning searchlights.

Flt. Lt. B. Oliver, R.A.F.V.R., who has been awarded a Bar to his D.F.C.

Sgt. D. M. MARTIN, No. 148 Sqn.—Since May, 1942, Sgt. Martin has flown continuously on operations. He had ceased operational duty when the present advance of our forces began in the Western Desert. With undiminished keenness he returned to operational flying, making attacks on enemy transports and tank concentrations with considerable success.

Sgt. J. G. MILLER, No. 39 Sqn.—This airman has taken part in a number of torpedo strikes against vessels and in attacks on enemy ports. Prior to being posted to the Middle East Sgt. Miller achieved much success in sorties from home bases and subsequently, in the Mediterranean, he obtained hits on two motor vessels and a tanker. As an air gunner this airman has damaged five enemy aircraft.

Sgt. G. E. MUSK, No. 148 Sqn.—Since May, 1942, Sgt. Musk has flown continuously on operations. In July, 1942, he participated in many operational sorties, and during a period of intensive operations flew in attacks against the enemy eight times in nine nights.

Sgt. R. A. H. SNOW, No. 37 Sqn.—Sgt. Snow has taken part in many operational sorties against objectives in Cyrenaica and enemy occupied territory in Egypt. Throughout he has maintained an exceedingly high standard of efficiency.

Sgt. M. SPINLEY, R.N.Z.A.F., No. 37 Sqn.—Sgt. Spinley has completed many operations, mainly as a captain of aircraft. He has participated in a large number of long-distance sorties, including raids on objectives in Cyrenaica, Crete and enemy occupied territory in Egypt. Towards the end of his tour he had some hazardous experiences; on one occasion he crashed at night, and another time he flew his aircraft home on one engine. He was ordered to rest, but in a few days requested to be allowed to resume operational flying.

Sgt. N. G. STEWART, R.A.A.F., No. 148 Sqn.—Sgt. Stewart has taken part in a large number of operational sorties, and has achieved remarkably successful results. He has attacked Tobruk many times, and twice during August, 1942, caused explosions and large fires. On one occasion in September, 1942, he made four runs during an attack on an enemy airfield, and his bombs burst, amidst the dispersed aircraft.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations:—

Distinguished Service Order

Act. Sqn. Ldr. A. W. SOUTHALL, No. 179 Sqn.—Sqn. Ldr. Southall has been a most valuable member of his squadron since its formation in October, 1942. His comprehensive technical and operational knowledge has been of the greatest value. Sqn. Ldr. Southall has made a number of successful attack on U-boats in the face of severe opposition.

Flt. Lt. A. P. SMALLMAN, R.A.F.V.R., No. 202 Sqn.—Flt. Lt. Smallman is an outstanding captain of aircraft and a most skilful pilot. At one period of stress he completed 360 hours' operational flying in just over five weeks. In the face of intense opposition he has made several attacks on U-boats.

Distinguished Flying Cross

Act. Sqn. Ldr. C. W. PASSEY, R.A.F.V.R., No. 89 Sqn.—In operations in North Africa, this officer has performed much excellent work which has been reflected in the successes obtained by the flight he has so skilfully led. Twenty enemy aircraft have been destroyed at night, three of them by Sqn. Ldr. Passey.

F/O. A. L. M. SPURGIN, R.A.A.F., No. 89 Sqn.—In operations in North Africa this officer has destroyed five enemy aircraft. He is a skilful and courageous pilot, whose fine example has been an inspiration to others.

P/O. R. L. SMITH, D.F.M., R.A.F.V.R., No. 137 Sqn.—Since being awarded the D.F.M., P/O. Smith has taken part in numerous operational flights, including attacks on shipping and railways. On one occasion he engaged four Fw 190s and seriously damaged one of them. Although his own aircraft also received severe damage during the combat, he flew it safely to base and effected a masterly landing.

V.C.'s Aircrew

F/O. G. R. ROYDE, R.A.F.V.R., No. 149 Sqn.
P/O N. E. SKINNER, R.A.F.V.R., No. 149 Sqn.

On November 28th, 1942, these members of an aircraft crew took part in an attack on a target at Turin. Whilst over the target area, their bomber was repeatedly hit by anti-aircraft fire, and sustained much damage. A shell, which burst in the cockpit, rendered the captain, the late Flt. Sgt. Middleton, V.C., unconscious and wounded the second pilot, Sgt. Hyder, in the face and legs; P/O. Skinner, the wireless operator, was also wounded in the leg. Despite his injuries, Sgt. Hyder took over the controls and succeeded in regaining control of the aircraft which had dived from 2,000 to 800 feet. Later the bomb load was released. Shortly afterwards, the captain recovered consciousness but Sgt. Hyder, after receiving first aid, insisted on remaining beside him in case of emergency. On the return flight, when crossing the Alps, Flt. Sgt. Cameron and Sgt. Gough greatly assisted the pilot to maintain height by jettisoning all movable equipment. Skilful navigation by F/O. Royde enabled the aircraft to be flown back to this country. Shortly after crossing the coast the aircraft had to be abandoned owing to lack of petrol.

Act. Flt. Lt. P. L. ARNOTT, R.A.F.V.R., No. 130 Sqn.—This officer has completed a very large

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number of operational missions, including sorties over Holland, Northern France and Brittany.

P/O R. A. MILLER, R.A.F.V.R., No. 89 Sqn.
P/O F. J. TEARLE, R.A.F.V.R., No. 89 Sqn.

P/Os Miller and Tearle have flown together, as pilot and observer respectively, on numerous night operations. They have destroyed four enemy aircraft and inflicted damage on three enemy E-boats.

W/O J. R. PHILLIPSON, No. 89 Sqn. (since deceased).—W/O Phillipson has invariably displayed outstanding skill and courage during air operations. Recently as observer he participated in the destruction of three enemy aircraft by night.

Wing Cdr. H. T. SUTTON, O.B.E., No. 614 Sqn.—This officer has set a magnificent example to all in his squadron. The great success achieved by his unit is directly attributable to his personal leadership.

Sqn. Ldr. G. H. NELSON-EDWARDS, R.A.F.V.R., No. 93 Sqn.—This officer has destroyed at least three enemy aircraft. In addition his fine leadership during several low-level machine gun attacks has enabled highly successful results to be achieved.

Sqn. Ldr. D. SECRETAN, No. 242 Sqn.—Sqn. Ldr. Secretan has led his squadron with distinction during a difficult period and by his fine example he has maintained a high standard of morale in the unit. Under his brilliant leadership in North Africa the squadron has destroyed more than 30 enemy aircraft.

Sqn. Ldr. W. B. WOODS, R.C.A.F., No. 400 (R.C.A.F.) Sqn.—This officer has completed numerous operational sorties, several of which involved long-distance flights over enemy-occupied territory. Sqn. Ldr. Woods has invariably displayed fine leadership and pressed home his attacks in a most determined manner.

Flt. Lt. G. BEDFORD, R.A.F.V.R., No. 81 Sqn.—Flt. Lt. Bedford has led his flight on all its operations since March, 1942. He has destroyed one enemy aircraft.

Flt. Lt. B. P. W. CLAPIN.—This officer has taken part in many operational sorties, the majority having been shipping reconnaissances, which involve a high degree of navigational skill. He has also participated in the combined operations at Dieppe and in patrols over Germany and Holland.

Flt. Lt. D. N. FORDE, No. 72 Sqn.—Flt. Lt. Forde has a long record of operational flying. At the commencement of the war he served in France and later fought in the Battle of Britain. Since October, 1942, in North Africa, Flt. Lt. Forde has successfully led formations on many sorties and machine gun attacks, in which enemy transport has been damaged. He has destroyed at least three enemy aircraft.

Flt. Lt. F. H. STEPHENSON, R.A.F.V.R., No. 608 Sqn.—In the last eighteen months Flt. Lt. Stephenson has taken part in several successful low-level attacks on enemy shipping and harbours, despite heavy opposition. As the bombing leader of the squadron, he has shown exceptional keenness in the development and demonstration of low-level and other bombing attacks. On one occasion Flt. Lt. Stephenson attacked a submarine which was partly surfaced and inflicted severe damage on the vessel.

Act. Flt. Lt. A. C. MILLER, R.A.F.V.R., No. 13 Sqn.—Flt. Lt. Miller, as squadron gunnery leader, has always shown extreme keenness and has done much to instil a fine fighting spirit into the other air gunners.

F/O. F. A. AIRMAN, R.C.A.F., No. 134 Sqn.—This officer has taken part in 21 sorties over enemy territory from England. Since his arrival in Algeria he has destroyed three enemy aircraft and shared in the destruction of three others.

Distinguished Flying Medal

Flt. Sgt. L. A. HYDER 149 Sqn.
Flt. Sgt. D. CAMERON, No. 149 Sqn.
Sgt. H. W. GOUGH, No. 149 Sqn.

For citations, see F/O. Royde and P/O Skinner.

Flt. Sgt. D. A. NORRIS, No. 89 Sqn.—During operations in North Africa, this airman rendered excellent service. He has taken part in the destruction of five enemy aircraft at night. He has set an admirable example.

Sgt. J. H. VICKERS, No. 614 Sqn.—One night in December, 1942, this airman was the air gunner of an aircraft which attacked the docks at Bizerta. During the operation his aircraft was hit by fire from the ground defences, and Sgt. Vickers was wounded in the foot, while his parachute and the aircraft dinghy were set on fire. Despite his injuries he left his turret, which he operated by hand as the hydraulics were unserviceable, and threw the parachute and dinghy out of the aircraft, thus extinguishing the fire and enabling the aircraft to be brought safely back to base.

Sgt. J. G. TREBELL, No. 89 Sqn. (since deceased).—As observer, this airman has displayed high courage and skill in flying operations. Recently he took part in the destruction, despite strong opposition, of four enemy aircraft by night.

Flt. Sgt. K. H. ELVIDGE, No. 500 Sqn.—Since the commencement of the war Flt. Sgt. Elvidge has completed much operational flying as a wireless operator/air gunner. His missions have included attacks on shipping in enemy waters and anti-submarine patrols in the North Atlantic, the Bay of Biscay and the Mediterranean Sea. Flt. Sgt. Elvidge has taken part in several successful attacks on enemy U-boats and has probably destroyed one enemy aircraft.

Flt. Sgt. C. HANSON, No. 608 Sqn.—Flt. Sgt. Hanson has been flying on operations for the last 15 months, during which time his missions have included attacks on enemy shipping and patrols along the Norwegian coast. On his first operational sortie he successfully flew his aircraft home after it had been attacked by three Me.109s, 250 miles from base. Flt. Sgt. Hanson has consistently displayed high courage and complete disregard for enemy opposition. On one occasion he made a skilful and successful attack against an enemy U-boat.

Three Years' Operations

Flt. Sgt. A. E. WILKINS, No. 500 Sqn.—R.A.F.V.R.—Flt. Sgt. Wilkins has been continuously engaged on operational flying since April, 1940. He has taken part in attacks on shipping, patrols off the enemy coast and anti-submarine operations in the North Western Approaches, the Bay of Biscay and the Mediterranean Sea. He was a member of the crew of an aircraft that successfully attacked a U-boat in the face of heavy and accurate fire. His aircraft sustained such severe damage that the pilot was forced to descend on the sea. The navigator was wounded and although the aircraft was sinking rapidly, Flt. Sgt. Wilkins, assisted by another member of the crew, managed to rescue him. During the hours spent in the dinghy before they were rescued, Flt. Sgt. Wilkins' cheerful attitude materially helped to maintain high spirits among his companions.

Flt. Sgt. D. V. SYMONDSON, No. 114 Sqn.—Flt. Sgt. Symondson has a meritorious record as a wireless operator/air gunner in three different theatres of war. He has taken part in almost all types of bombing operations, including attacks on enemy shipping.

MODERN DICK WHITTINGTON: With only 13 kilometres to go for Castel Benito, an L.A/C. takes a mug of tea and reads the book of instructions.

Flt. Sgt. S. WOODWARD, No. 223 Sqn.—In November, 1942, this airman made three attacks on enemy U-boats. On November 1st, 1942, he attacked a submarine in the Mediterranean and forced it to surface. He then made a second attack despite heavy opposing fire. His aircraft was badly damaged and Flt. Sgt. Woodward was forced to break off the action. Later in the same month he made an attack on a U-boat in the Atlantic, following this with a successful attack on a U-boat in the Mediterranean two days later.

Sgt. E. H. SMITH, No. 233 Sqn.—On November 6th, 1942, whilst engaged on an anti-submarine sweep, Sgt. Smith damaged an enemy U-boat severely and successfully prevented it from surfacing. Later in November he sighted and reported another submarine which was also successfully attacked. In addition, Sgt. Smith and his crew have twice located crews of aircraft adrift in their dinghy and been instrumental in their subsequent rescue.

Flt. Sgt. B. McFADDEN, R.A.A.F., No. 69 Sqn.—Flt. Sgt. McFadden has taken part in many sorties over the Mediterranean Sea. One night in November, 1942, he successfully attacked an enemy merchant ship in the face of heavy opposing fire from its escorting destroyer.

Flt. Sgt. R. L. SPENCE, R.C.A.F., No. 40 Sqn.—This airman has completed numerous operational missions, twelve of them as captain of aircraft. In October, 1942, during an attack on Tobruk, his aircraft was badly damaged by anti-aircraft fire and he and his crew were forced to abandon it near El Adem. Flt. Sgt. Spence, with two of his comrades, set out on the long trek to our lines at El Alamein. One of the party was compelled to drop behind but, for 28 days, Flt. Sgt. Spence and his companion continued the journey. They successfully evaded enemy columns and camps and were eventually saved by a British patrol. Since reaching safety, Flt. Sgt. Spence has participated in four attacks on targets at Tunis and Sousse.

Sgt. D. G. CLARKE, No. 14 Sqn.—As wireless operator/air gunner, Sgt. Clarke has performed much highly meritorious work. He has often acted as fire controller in the leading aircraft of bomber formations. During an intruder sortie over Crete in June, 1942, his skilful use of his wireless apparatus contributed materially to the great success of the operation. On another occasion, in November, 1942, the aircraft in which he was flying was damaged by enemy action and a fire broke out near the rear tanks. Sgt. Clarke immediately attempted to quell the flames with an extinguisher. When it was exhausted he finally beat out the fire with his bare hands.

Sgt. R. FLORENCE, No. 214 Sqn.—This airman, who has participated in many sorties, has displayed great skill both as air bomber and front gunner. On one occasion, at Vegesack, his accurate shooting extinguished many searchlights which menaced his aircraft whilst flying at low level. One night in December, 1942, during an operational sortie, he effectively silenced a gun of an armed ship with well-aimed bursts. One night in January, 1943, during an attack on Lorient, he displayed great determination in attacking searchlight positions.

Sgt. D. TAYLOR, No. 14 Sqn.—In December, 1942, this airman was the rear gunner of an aircraft engaged on a reconnaissance flight over the Tunisian Road. During the operation his aircraft was attacked by an enemy fighter. Although unsupported by the guns from another turret which had jammed, Sgt. Taylor resolutely fought on alone. He was wounded in the left thigh and right shoulder, but, despite this, he maintained his fire and shot down the attacker with a burst from close range.

Sgt. L. A. EINSAAR, R.A.A.F., No. 14 Sqn.—Sgt. Einsaar is a skilful and determined pilot who has completed many sorties. In November, 1942, during a reconnaissance over the sea, he saw two enemy convoys, and reported their positions accurately. Some days later, he executed a low level attack on some barges in Benghazi harbour, setting two of them on fire. He skilfully accomplished the return flight of 700 miles to base, being the first member of his squadron to achieve this in the type of aircraft he was flying. During a sortie in December, 1942, his aircraft was severely damaged when attacked by enemy fighters. When his aircraft could no longer be flown, whilst over the sea 50 miles out from Benghazi, Sgt. Einsaar skilfully came down on the water. The aircraft caught fire but he managed to get clear of the blazing wreckage and some 3½ hours later was picked up by a naval launch.

Sgt. S. J. KERMACHEN, R.C.A.F., No. 252 Sqn.—Sgt. Kermachan is a first-class pilot with a fine operational record. He has participated in very many sorties, involving attacks on shipping and transport in the battle area, and inflicted much loss and damage. In addition, he has destroyed four enemy aircraft. On one occasion, during an engagement in which he shot down a Ju 87, his own aircraft was badly damaged but he flew it safely to base.

Flt. Sgt. D. R. BEARD, No. 73 Sqn.—In the fighting in the Western Desert this airman has taken part in a very large number of sorties, many of them at night. He has destroyed two Ju 88s. In attacks on ground targets he has destroyed many enemy vehicles, setting them on fire; he also destroyed a searchlight and two gun positions.

THE KING has been graciously pleased to approve the following award:—

B.E.M. (Mil.)

Cpl. O. SKELTON.—During an attack on a R.A.F. Station, by two enemy aircraft one morning in July, 1942, four bombs fell in residential quarters. Cpl. Skelton was billeted in a house nearly opposite to the place where the first bomb exploded and immediately went to the spot and brought out two injured civilians from demolished houses. He subsequently displayed outstanding courage in extinguishing a fire beneath the rubble. To achieve this he twice crawled through a hole in the wreckage, and in so doing showed complete disregard for his own safety in view of the overhanging debris which was likely to collapse and bury him. Cpl. Skelton received minor injuries and finally collapsed after his strenuous efforts; he was removed to hospital for treatment.

Sgt. A. S. DONALDSON.—In 1942 this N.C.O. was in charge of a bomb dump guard when an aircraft crashed in the vicinity. On hearing the crash, which had occurred about 30 yards away, he called together the guard, collected a fire extinguisher, and hurried to the aircraft. He tried to open the doors, but found them both jammed. He then moved to the front of the machine, and saw one of the occupants hanging by his harness. He climbed through the wreckage and, assisted by one other member of the guard from the outside, with great difficulty extricated the occupant from the harness and wreckage. Meanwhile, escaping petrol and the

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port engine of the aircraft had burst into flames, which considerably increased the difficulties of his task. At this stage he noticed for the first time the other occupant, the pilot of the aircraft, who was lying on his back underneath the wreckage with his head in the flames. Without hesitation Sgt. Donaldson took off his tunic, and with extreme difficulty succeeded in covering the head of the pilot; in so doing he sustained burns on the hands and arms. Sgt. Donaldson saw that, alone, he was unable to do more for the pilot, so he turned his attention again to the other member of the crew. He dragged the latter some 20 yards clear of the machine, and attended to him. By this time personnel from the dispersal point arrived, and, together with the members of the guard, they succeeded in dragging the wreckage away from the pilot, whose legs were entangled in the controls. He was pulled clear and wrapped in blankets until the arrival of the ambulance.

L.A/C. H. D. HARTLE.—One night in November, 1942, an aircraft which had taken off from an airfield crashed and burst into flames. L.A/C. Hartle, who was billeted near the scene of the crash, left his home and made his way with considerable difficulty to the burning aircraft. He was the first to arrive on the scene, and immediately endeavoured to render assistance to the crew. The mid-upper gunner was trapped by the legs and was hanging head downwards in his turret, which was on fire, and surrounded by burning debris. Undeterred by the intense heat and the explosion of ammunition, L.A/C. Hartle, using his own body to shield the injured gunner from the flames, extinguished the fire in the immediate vicinity of his head, and succeeded in extricating him before further help arrived.

Sgt E. G. THOMPSON, R.A.A.F.—On September 8th, 1942, Sgt. Thompson was gunner in an aircraft performing air exercises at a bombing and gunnery school. After completing the exercises the aircraft stalled, crashed and burst into flames. As it struck the ground, Sgt. Thompson leapt clear and went to the assistance of the pilot, who was trapped in the blazing aircraft. He was unable to release the pilot from the starboard side and ran to the port side. The wreckage was burning fiercely, but Sgt. Thompson went without hesitation into the midst of the flames in a further attempt to extricate the pilot. He struggled violently with the wreckage, but could not effect the release of the pilot, who was burned to death. Sgt. Thompson had received second degree burns to the face and third degree burns to the hands and had continued his courageous efforts until ordered to the ambulance. Even then he expressed a desire to return to the wreckage and resume the attempt to release the pilot.

Roll of Honour

Casualty Communiqué No. 211.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths. Of the names in this list five are second entries, giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—P/O. J. D. Anderson; F/O. P. F. B. Bluett; P/O. N. H. Bowack; Sgt. W. Brown; Sgt. M. S. D. Corker; Flt. Sgt. R. G. Fawkes; Sgt. G. Longbottom; Flt. Sgt. T. R. Marshall; Flt. Sgt. D. A. Miner; Sgt. J. Nicol; F/O. H. J. P. Tyson; P/O. J. B. Underwood; Sgt. A. Williamson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. P. H. Crabb; F/O. D. A. Hamilton; P/O. H. S. Keeton; Sgt. R. F. Southern; P/O. J. F. Stanley.

WOUNDED OR INJURED IN ACTION.—Sgt. W. H. Newham.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. G. W. Brothwell; Sgt. T. L. Davies; Sgt. A. Dunbar; Sgt. F. J. Edwards; Act. Flt. Lt. E. F. G. Healey, D.F.C., D.F.M.; Sgt. C. H. Jurgensen; Sgt. M. W. Lavelle; P/O. M. H. Lumley; Sgt. R. Lyall; Sgt. D. C. Nelson; Sgt. F. A. O'Dwyer; F/O. J. R. Pennington, D.F.C.; Sgt. R. E. Whiteman.

MISSING.—Flt. Sgt. C. C. N. Bailey; Sgt. F. J. Baker; Flt. Sgt. D. M. Boon; Flt. Sgt. L. R. Brettle; Flt. Sgt. C. M. Browning; Sgt. H. F. Burton; Flt. Sgt. C. W. Chatterley; Sgt. R. L. Chitty; Sgt. K. M. Clarke; Sgt. S. Coates; Sgt. S. Cookson; Sgt. H. Cowan; Sgt. H. Cowlishaw; P/O. J. Davies, D.F.M.; Sgt. J. J. Dixon; Sgt. S. E. English; Act. Flt. Lt. D. S. Gillett; Sgt. J. D. Goldie; Sgt. J. E. L. Griffiths; Sgt. A. S. Grove; Sgt. A. F. Haden; P/O. R. H. W. Hatt; Sgt. J. Henderson; P/O. R. W. Henly; Flt. Sgt. W. Higgins; F/O. G. S. Jeffreys, D.F.C.; Sgt. E. A. Kelly; Sgt. G. Lyons; Act. Flt. Lt. J. McMillan; Flt. Sgt. J. C. Morgan; Sgt. P. W. Newbegin; F/O. J. E. Northend; Sgt. C. J. D. Osborne; Sgt. R. Paxton; Sgt. W. Ramsey; Sgt. A. Rees; Sgt. E. Roberts; Flt. Sgt. P. A. J. Rudkin; Sgt. J. H. Sheppard; Sgt. B. Simmons; Flt. Sgt. D. Smith; Sgt. H. A. Smith; Flt. Sgt. K. C. Taylor; Sgt. M. J. F. Teasdale; Sgt. S. G. Vials; P/O. C. A. Watts; Sgt. E. H. Woods.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Act. F/O. R. Broad; L.A/C. F. C. Curtis; Sgt. J. Luke; Sgt. J. S. Stephens; L.A/C. R. F. Stephenson; L.A/C. A. W. Sutton.

KILLED ON ACTIVE SERVICE.—Sgt. J. M. Allen; Cpl. W. A. Ashworth; Sgt. K. A. Brooks; Sgt. F. G. Brown; Sgt. G. Campian; P/O. D. McL. Cameron; L.A/C. L. H. Carter; A/C.1 A. D. Casey; Act. Sqn. Ldr. R. G. Chester; P/O. D. F. S. Clark; Sgt. N. Clarke; Act. Sqn. Ldr. H. W. Cleland; F/O. G. G. Cowlin; P/O. R. Cowin; L.A/C. T. Dawes; P/O. M. T. Dickinson; Sqn. Ldr. D. M. Foreman, D.F.C.; P/O. J. A. Foulkes; L.A/C. S. E. Gatley; L.A/C. H. P. Gilchrist; Group Capt. R. R. Greenlaw, M.B.E.; A/C.2 B. G. B. Hadrill; F/O. H. F. Hamilton; Flt. Lt. F. C. B. Harrison; P/O. R. Harwood; P/O. W. A. Hawkins; Sgt. O. V. G. Hay; Sgt. W. J. Hayward; Sgt. F. R. W. Henderson; Cpl. F. W. Heywood; Sgt. J. Hunter; L.A/C. A. J. W. Hurdle; P/O. E. R. D. James; P/O. D. W. C. Jepp; L.A/C. L. C. Lawrence; Cpl. T. W. Lewzey; P/O. G. W. Lean; Flt. Sgt. A. Lord; Air Vice-Marshal W. A. McClaughry, C.B., D.S.O., M.C., D.F.C.; Sgt. G. S. McGregor; Sgt. P. De V. McMahon; P/O. N. Matthews; L.A/C. R. Medina; Sgt. D. W. Miles; Act. Sqn. Ldr. G. E. Milnes; Cpl. H. L. Munson; Sgt. J. Murray; Act. Wing Cdr. G. B. Nicholas, D.F.C.; Sgt. A. G. H. Nichols; Sgt. W. H. J. Nott; Flt. Sgt. F. V. Passant; Sgt. W. S. Peacock; Sgt. F. R. Potter; Sgt. C. Ring; Flt. Lt. J. R. Ritchie; Sgt. D. W. Sanderson; Sgt. F. H. Sherriff; Flt. Lt. J. S. Simons, A.F.C.; Sgt. J. R. Simpson; A/C.2 L. L. Smith; P/O. G. J. T. Snoxell; Sgt. B. Sober; Sgt. L. G. Spires; Flt. Sgt. T. J. G. Thomas.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. J. G. Arnold; Flt. Sgt. J. H. Baker; A/C.2 A. S. Baum; L.A/C. L. Biggs; L.A/C. J. W. C. Blackie; L.A/C. L. J. Boniface; Flt. Lt. C. J. McN. Bowie; Sgt. F. W. Clarke; P/O. F. N. Davie; Sgt. S. G. Docker; Cpl. R. D. Edwards; Flt. Sgt. J. M. P. Gourley; L.A/C. G. Harrington; Sqn. Ldr. C. H. N. L'Estrange; Sgt. P. R. Leigh-Morgan; L.A/C. W. McNeil; Sgt. A. Osborne; Sgt. D. Prowse; F/O. N. C. Robertson; P/O. F. Sandy; F/O. E. D. Savage; L.A/C. J. Sharman; Sgt. J. H. K. Tait; L.A/C. E. Wasservogel.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.1 E. Greensmith; Act. P/O. W. A. Hodgins; Sgt. H. Spinner; Cpl. M. Swift.

DIED ON ACTIVE SERVICE.—A/C.2 D. D. Brotherick; Cpl. W. Brown; Flt. Sgt. C. H. Curling; L.A/C. G. W. France; Sgt. P. F. Kingsnorth; Act. Cpl. R. E. McCririck; A/C.2 C. Metcalfe; L.A/C. G. W. Newell; A/C.1 G. T. Raymond; L.A/C. W. Sutherland; L.A/C. R. F. Wyatt.

Royal Australian Air Force

MISSING.—Sgt. R. J. Booth; P/O. G. H. Burkett; Sgt. R. J. Burns; P/O. J. I. Craig; Sgt. E. J. Gleeson; Act. Flt. Lt. G. F. Jackson; P/O. K. J. Murphy; Sgt. W. C. Salmond; Sgt. H. Witte.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. A. G. Rees.

KILLED ON ACTIVE SERVICE.—L.A/C. J. L. Horne; L.A/C. M. B. Thompson; L.A/C. T. F. Waugh.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. R. P. Gurney; L.A/C. W. J. Kelly; L.A/C. F. Mellow.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. G. M. Bartsch; L.A/C. B. M. Gates.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. J. H. Charles; P/O. J. D. Patey.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. B. E. Atwood; P/O. D. M. Crozier, D.F.M.; F/O. G. C. M. McCann; Sgt. F. J. McKeown; Flt. Sgt. J. B. Nault; Flt. Sgt. O. S. O'Hair.

MISSING.—Sgt. A. G. G. Brown; Sgt. R. J. Cowan; Sgt. D. Crosthwaite; P/O. K. H. Dalton; Flt. Sgt. B. E. Hargrove; P/O. L. T. Jackson, D.F.C.; Sgt. A. J. Kenney; Sgt. J. Maguire; Sgt. J. C. McNeill; Sgt. W. H. McQ. Maxwell; Flt. Sgt. S. R. Millar; W/O. W. G. Pavely; Sgt. E. W. Roberts; F/O. S. C. Shusterove.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—L.A/C. W. A. Allan; W/O. H. F. Burt-Gerrans; Sgt. E. H. Caldwell; F/O. J. K. Potter.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. A. C. Aitken; Sgt. J. G. L. Belanger; Sgt. R. V. Bridgeman; Sgt. F. C. Zurbprigg.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. A. W. Dungate; Sgt. F. E. Fry; Flt. Sgt. J. A. Reynolds.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. E. E. Fisher.

DIED ON ACTIVE SERVICE.—P/O. L. G. Burke; W/O. D. J. Hartney.

Royal New Zealand Air Force

KILLED IN ACTION.—P/O. B. Usher.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. L. D. Enright; Sgt. B. L. Peterson.

MISSING.—Sgt. R. A. Banks-Martin; Sgt. J. Ellis.

KILLED ON ACTIVE SERVICE.—Act. Flt. Lt. V. E. Sutherland.

South African Air Force

MISSING.—Flt. Sgt. M. M. Coigzee; Flt. Sgt. K. A. Duncan; Air Sgt. S. A. Maritz; Lt. L. F. Walthers.

DIED ON ACTIVE SERVICE.—Flt. Sgt. F. H. Perry.

Indian Air Force

KILLED ON ACTIVE SERVICE.—Flt. Lt. G. I. Khuotsiaw.

Casualty Communiqué No. 212.

Of the names in this list twenty are second entries, giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. A. Campbell; Sgt. C. Cosens; Sgt. G. E. Deacon; Sgt. D. A. D. Golby; Sgt. T. Holliday; Sgt. A. A. J. Mills; Sgt. D. Philp; F/O. C. L. W. Popplestone; Sgt. W. J. Pye; Sgt. E. E. J. Sillitoe; Sgt. J. C. Warburton; Sgt. G. Welch; Sgt. G. H. Whyte; Sgt. C. P. Wilcock; Sgt. D. H. Woods.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. L. Newton; Sgt. D. H. Normington; P/O. T. E. R. Wood.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. K. G. Armstrong; P/O. R. V. Brosmer; Sgt. E. A. Corderoy; Flt. Sgt. S. D. Jones; Sgt. F. E. MacKenzie; Sgt. J. R. Pendlebury; Sgt. E. G. Seaward; Sgt. R. Smith; Sgt. L. Starbuck; Sgt. H. R. Strain; Sgt. S. J. Webster; Flt. Sgt. G. Willis.

WOUNDED OR INJURED IN ACTION.—Sgt. N. H. Dalton; Sgt. W. T. Henderson; Flt. Sgt. G. D. I. Neale; Sgt. T. W. Ralph.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. G. T. Dawson; Sgt. F. R. Jones.

MISSING, BELIEVED KILLED IN ACTION.—P/O. M. J. Glover; Act. Flt. Lt. D. H. S. Lonsdale; Sgt. J. I. Morris; Sgt. A. T. Riley; Sgt. A. D. Smitherman.

MISSING.—Sgt. S. McK. Anderson; Sgt. R. Babington; Sgt. J. Bell; Sgt. C. Bentley; Sgt. A. Campbell; Act. Sqn. Ldr. P. W. M. Carlyon, D.F.C.; Sgt. L. Carr; Sgt. W. T. C. Chambers; Cpl. R. E. Chandler; Flt. Lt. A. R. Chaplin; Sgt. A. J. Chester; Flt. Sgt. G. A. Coutts; Flt. Sgt. L. W. Cronk; Sgt. E. B. Davies; Sgt. I. D. Drysdale; Sgt. A. W. Edwards; F/O. R. C. Finn; Sgt. J. J. Gadd; F/O. G. D. Garrod; Flt. Sgt. R. Gray; Sgt. E. F. Greenshields; F/O. F. D. W. Greatrex; F/O. J. H. Haigh; Sgt. M. Harris; A/C.1 K. H. Hutchinson; W/O. D. L. Iremonger; Sgt. C. N. Judd; Sgt. J. L. Kemp; Sgt. C. MacIntyre; Sgt. A. R. Maddison; Sgt. J. R. Mallinson; Sgt. L. P. Manning; Sgt. H. G. Martins; Sgt. T. Miller; Sgt. G. E. P. O'Connor; Sqn. Ldr. E. D. J. Parker, G.C., D.F.C.; Sgt. T. J. Pritchard; Sgt. C. E. C. Ransom; P/O. H. S. Readhead; Sgt. R. T. Southcott; Sgt. H. H. Steele; Sgt. N. B. Q. Stevenson; Sgt. L. H. Tabner; F/O. D. V. Varian; Sgt. E. Walker; Sgt. T. J. W. Wilcox; Sgt. W. Wilson; Sgt. E. H. Wright.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. D. C. Brooks; Sgt. C. Edwards; Flt. Sgt. J. J. Finn; Sgt. G. Hewitt; Sgt. G. G. Ottley; Sgt. B. H. Parker.

KILLED ON ACTIVE SERVICE.—Sgt. H. F. Aked; Sgt. J. H. Atkinson; Flt. Sgt. R. V. W. Bellew; P/O. D. M. Bennett; P/O. J. C. Broodrie; Sgt L. W. Bridger; Sgt. E. T. Brocklehurst; Sgt. S. S. Bushell; L.A/C. S. Cliff; Sgt. A. J. Dubben; Sgt. L. G. Firmage; P/O. H. N. Franklin; Sgt. J. M. Gilmour; P/O. R. S. Goodwin; Sgt. R. B. Govett; P/O. R. Herries; Sgt. W. F. Hewett; Sgt. G. W.

Amir Fawwaz esh Shaalan, Chief of Ruwallas, inspects a Baltimore during a visit to Cairo.

SERVICE AVIATION

Hicks, Sgt. J. H. Hobbs; Sgt. I. Jackson; Sgt. J. Jones; A/C.2 L. C. Keat; Sgt. R. E. Keene; Cpl. D. J. Le Masurier; A/C.1 I. Lieberman; P/O. C. H. W. MacKintosh; Sgt. J. Miles; L.A/C. W. J. Mordue; A/C.2 J. Morrow; Sgt. L. C. Muston; P/O. E. J. H. Nash; A/C.1 C. R. Newson; Sgt. R. F. Norwood; P/O. J. N. Roberts; F/O. T. D. Robertson; Sgt. J. H. Robson; Sqn. Ldr. D. O. Rohde, D.F.C.; Sgt. J. Rose; Sgt. L. F. Simpson; Sgt. A. Smith; Sgt. J. F. Stanger; Act. Flt. Lt. E. V. Stanley-Jones; Sgt. W. Thompson; Sgt. J. S. Todd; Sgt. K. N. Tulloch; P/O. A. E. Usher; A/C.1 A. Walker; Sgt. T. D. Watson; A/C.1 R. A. Waskett; F/O. P. K. White; F/O. P. K. Woodsend.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. R. Cunningham; P/O. R. E. C. Ebsworth; Sgt. G. R. Waters.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Cpl. H. J. Bastion; L.A/C. S. W. Bealing; A/C.1 R. Benham; Sgt. R. S. Breeze, D.F.M.; Sgt. D. Campbell; A/C.2 J. W. Coutts; Cpl. J. W. Edwards; A/C.1 A. Gay; A/C.2 T. Hold; A/C.1 J. Hutchinson; Sgt. R. M. Jenkins; L.A/C. S. V. King; Sgt W. O. Laggett; P/O. E. Morgan; A/C.1 J. Pickering; A/C.2 C. M. Read; A/C.1 N. E. Smith.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.1 A. Cheyne; L.A/C. P. C. Cole; L.A/C. C. A. A. Hardy; F/O. K. A. Marriott; L.A/C. B. Thrupp; A/C.1 W. White.

DIED ON ACTIVE SERVICE.—A/C.2 G. W. Chapman; A/C.2 W. G. Claxson; L.A/C. J. F. Croft; Cpl. G. Hancock; L.A/C. A. A. Harvey; A/C.1 A. R. Jones; L.A/C. H. Lee; Act. Sqn. H. De M. Middleton; A/C.1 A. E. Mouncher; L.A/C. R. A. Preston; A/C.1 A. D. Sawyer; A/C.1 J. Ward; L.A/C. J. Wilson; A/C.2 J. E. Wood; L.A/C. W. G. Yardley.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. C. Armitage.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—Flt. Officer. P. I. Lawrence.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. J. A. Linton; Sgt. R. Thiele.

WOUNDED OR INJURED IN ACTION.—Sgt. P. W. McNaughtan.

MISSING.—Sgt. R. D. MacKenzie; Sgt. F. McKendrick.

KILLED ON ACTIVE SERVICE.—Sgt. J. G. S. Bell; Sgt. J. S. Dickson; Sgt. L. F. Ryan; Sgt. D. J. Wearne.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. A. L. Fox.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. L. Dickie; Sgt. R. R. Moore; P/O. K. R. Smith.

MISSING.—Flt Sgt. J. Aleo; Flt. Sgt. R. F. Bird; P/O. D. H. A. Dewar; Act. Wing Cdr. C. J. Fee, D.F.C.; Flt. Sgt. J. A. Hunter; Flt. Sgt. J. L. Kingsley; F/O. W. S. Large; Flt. Lt. J. H. Long; P/O. J. H. McPhee; F/O. G. A. McQuillin; Sgt. E. C. Malone; Flt. Sgt. J. R. Milligan; F/O. G. Milne; Flt. Sgt. L. B. Murray; Flt. Sgt. J. N. Peck; Flt. Sgt. M. A. Phair; P/O. P. F. Pinder; Sgt. J. A. Pollock; Flt. Sgt. J. E. Quinn; Sgt. C. H. Reed; P/O. W. W. Roy; P/O. R. C. Richards; Sgt. S. Q. Schrump; Flt. Sgt. H. W. Stewart; Sgt. W. J. Sullivan; Flt Sgt. R. C. Zavitz

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—F/O. W. V. Hall.

KILLED ON ACTIVE SERVICE.—Sgt. W. E. Barr; Sgt. W. J. A. Duplin; Sgt. J. J. A. Field; P/O. A. M. H. Gain; P/O. A. Higgins; Sgt. R. W. Lawton.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. C. A. Cowie; Sgt. G. M. Lipsett; L.A/C. A. H. MacDonald.

DIED ON ACTIVE SERVICE.—L.A/C. J. J. Lammerse; Sgt. J. R. V. Pettigrew.

Royal New Zealand Air Force

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. G. D. Loftus.

MISSING.—Sgt. J. A. Austin; Sgt. G. A. McKoy; F/O. D. K. O'Donnell; Flt. Sgt. G. G. Organ; Flt. Sgt. J. A. Tovey.

KILLED ON ACTIVE SERVICE.—Sgt. W. H. Barnett.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. M. R. Jack.

MISSING.—Act. Flt. Sgt. C. Engelbrecht; Lt. S. Lindenburg; 2/Lt. J. F. Van Ryneveld.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Lt. C. De Meillon; 2/Lt. L. H. Lechat.

Indian Air Force

DIED ON ACTIVE SERVICE.—A/C.2 B. I. Sundaram.

DISPERSAL MESS: Food for aircrews in N. Africa is sent to the dispersal points in special containers and the men help themselves as opportunity affords.

Casualty Communiqué No. 213.

Of the names in this list, 10 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. S. S. Angus; Sgt. F. Charlton; F/O. P. G. Daly; Sgt. J. Hallsworth; P/O. C. R. Hiles; F/O. F. J. Pile; Flt. Sgt. G. B. Potter; F/O. R. V. Weston.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. R. H. Crews; P/O. G. P. Elliott; Sgt. F. Swinburn.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Act. Sqn. Ldr. T. N. C. Burrough, D.F.C.; Sgt. L. W. Dann; Sgt. T. A. Evans; F/O. E. J. Harris; Sgt. D. S. Jones; Flt. Sgt. H. E. Turner.

WOUNDED OR INJURED IN ACTION.—Sgt. C. Terry, D.F.M.

MISSING, BELIEVED KILLED IN ACTION.—P/O. L. R. Adcock; Flt. Sgt. R. H. Bird; P/O. F. A. Bray Brook, D.F.M.; Sgt. J. Davis; Flt. Sgt. R. J. Finch; Sgt. R. G. Gait; Sgt. L. G. Gunning; Sgt. W. J. Harris; Sgt. C. C. Hayes; W/O. C. A. Howard; Sgt. G. J. Inglis; Flt. Sgt. J. Kinghorn; Sgt. I. W. Lineker; Flt. Sgt. F. D. McColl; Sgt. W. A. McMullan; Sgt. W. H. Moger; Sgt. A. Murray; F/O. G. F. B. Newport-Tinley, D.F.C.; Sgt. B. S. Nixon; Sgt. B. M. Pick; Sgt. K. H. Pugh; Flt. Sgt. W. G. Sheppard; Flt. Sgt. H. C. Taylor; F/O. H. J. R. Tickle; Sgt. C. A. Whiteside.

MISSING.—F/O. E. J. M. Albert; Sgt. F. B. Andrews; Sgt. J. S. Atkin; Sgt. G. A. Axup; Sgt. J. H. Bakewell; Sgt. D. J. Ball; Sgt. F. H. Baron; Sgt. J. Bell; L.A/C. R. A. Bond; Sgt. J. C. Brittain; Sgt. J. W. R. Broadley; P/O. W. Burt; Sgt. K. F. Butler; Sgt. E. Cadden; Sgt. E. A. O. Campbell; Sgt. W. J. Carter; P/O. E. R. Charlesworth; Sgt. J. G. B. Chilvers; P/O. A. R. Eckton; Sgt. P. H. B. P. Green; Sgt. G. McM. Hair; Sgt B. Hannaway; Sgt. F. Hanson; L.A/C. B. Hart; Sgt. H. G. Jenkins; Flt. Sgt. L. Jenkinson; Sgt. T. W. Jones; L.A/C. R. W. Johnson; Sgt. B. E. H. Kirkman; Sgt. L. Lamb; Sgt. P. Lane; P/O. F. R. Leonard; Sgt. W. Lewis; L.A/C. J. Little; Sgt. F. Logie; Sgt. A. McCabe; Flt. Sgt. F. C. Marsh; Sgt. J. Martin; Sgt. M. C. Moody; P/O. B. F. Morgan; Sgt. C. S. H. Morley; P/O. A. M. Murray; Sgt. H. D. Munro; Sgt. B. Naylor; Sgt. G. A. Newman; Sgt. P. J. Newman; Sgt. L. Noble; Sgt. F. Nuttal; Sgt. W. H. Pates; Sgt. P. H. Pearce; Sgt. D. T. Pitman, D.F.M.; Sgt. R. F. Poole; P/O. F. A. Read, D.F.C.; Sgt. R. W. Read; Sgt. G. H. Rowson; Sgt. A. R. Saunders; Sgt. F. R. Scargall; Sgt. T. R. D. Shirley; Sgt. G. D. Singleton; Flt. Sgt. B. K. Skinner; Sgt. K. E. Slade; Sgt. A. P. Smith; Sgt. W. J. Smith; Sgt. A. V. D. Stinton; F/O. L. E. Stockwell; Sgt. D. G. Thomas; P/O. C. G. Tilson; P/O. T. O. Truscott; Act. Sqn. Ldr. A. S. Turnbull; Sgt. H. R. Wakley; Sgt. J. H. Watson; Sgt. R. Waudby; Sgt. E. C. Webb; Sgt. D. H. Webster; Sgt. S. Wescombe; Sgt. J. E. West; Sgt. R. G. Wheeler; Sgt. L. Whiteside; Sqn. Ldr. M. A. L. Williams; Flt. Sgt. B. H. H. Wilson; F/O. M. H. G. Wilson; Sgt. R. Wilson; Flt. Lt. A. M. Wodehouse; Sgt. J. H. Worrow; Sgt. J. G. Wyatt.

KILLED ON ACTIVE SERVICE.—A/C.2 C. K. Allen; Sgt. D. Bell; Flt. Lt. G. L. Campbell, D.F.C.; L.A/C. S. Crouch; Sgt. J. Davidson; Sgt. D. K. Dickson; Flt. Sgt. R. T. C. Dixon; Sgt. K. J. Fielding; F/O. I. S. Galbraith; Sgt. R. J. Grimmitt; L.A/C. R. Lawther; Sgt. A. Little; Sgt. D. S. Lyford; P/O. R. P. Mason; Sqn. Ldr. A. B. Mitchell; Sgt. P. J. Miles; Act. Cpl. D. Smith.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. J. L. Loam; Act. Flt. Lt. K. L. Waud.

DIED ON ACTIVE SERVICE.—A/C.1 W. H. Atkinson; A/C.1 S. K. Arkskey; L.A/C. W. C. J. Bacon; L.A/C. L. Bamforth; W/O. F. R. Barlow; Flt. Lt. A. Blyth; L.A/C. P. G. Brookes; L.A/C. C. H. Cartwright; A/C.1 J. Clarke; L.A/C. W. H. Dyason; Cpl. J. Harris; A/C.2 A. E. Hibbett; A/C.1 F. W. Hollick; Flt. Sgt. J. R. Holmes; A/C.1 T. Howe; L.A/C. T. L. Laing; A/C.1 H. W. E. Hubble; A/C.2 B. G. Legg; Cpl. E. J. Morley; L.A/C. F. J. Mountford; F/O. R. H. L. Oakes; A/C.1 R. E. Parsons; A/C.2 C. E. Priest; A/C.1 J. A. Rhodes; Act. Sqn. Ldr. R. A. Salter; A/C.1 H. Stokes; A/C.2 R. D. Taylor; L.A/C. H. S. Urwin; A/C.1 A. Webster; A/C.2 D. N. West; Cpl. E. G. Whiteside; A/C.1 H. P. Wilkins; Cpl. P. Wilson.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 J. J. Thorning.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. D. A. Corfe.

WOUNDED OR INJURED IN ACTION.—Sgt. I. H. Roediger.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. W. D. Cheese.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. H. G. Brooks; Sgt. E. J. B. Fletcher; Sgt. H. P. Gray; Sgt. K. J. H. Harris; Flt. Sgt. R. T. Lonsdale; Flt. Sgt. J. H. Woodford.

MISSING.—P/O. A. N. Austin; Sgt. S. K. Campbell; Flt. Sgt. T. L. Gibson; P/O. A. Haley; Sgt. W. D. Henderson; Sgt. F. E. Hutchinson.

DIED ON ACTIVE SERVICE.—F/O. S. O. Bonus.

Royal Canadian Air Force

KILLED IN ACTION.—P/O. G. P. Mackay.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. H. V. Spicer.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. C. L. Graham.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. J. B. Chaster: Flt. Sgt. S. A. Goss; Sgt. H. E. Johnson; Sgt. R. J. Kee; Flt. Sgt. F. McL. MacDonald.

MISSING.—Flt. Sgt. H. C. Beebe; Sgt. F. A. Degruchy; Sgt. J. Fallis; P/O. H. F. Fansher; P/O. D. E. Hall; F/O. C. B. Haslam; Sgt. C. B. Hodges; Sgt. W. E. Johnson; Sgt. F. M. Lacasse; Sgt. J. O. M. Lebel; P/O. M. P. Massey; Flt. Sgt. L. P. McClive; Flt. Sgt. R. S. Rice; Sgt. J. Richards; Sgt. W. A. Rollings; Flt. Sgt. F. A. Webb; Sgt. D. A. White; P/O. J. Woolford.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. D. S. Cameron; Sgt. G. E. Walker.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. L. M. McLean; W/O. A. I. McFarlane.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. M. L. Fairles.

DIED OF WOUNDS ON INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. G. I. Morrison; F/O. T. H. O'Neill.

Royal New Zealand Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. E. Arnold; Sgt J. F. Lumsden; Sgt. D. Miller; Sgt. J. W. Murphy.

MISSING.—Sgt. K. R. Aicken; F/O. V. D. Benefield; F/O. J. G. Duffill; F/O. E. W. M. Jacombs; Sgt. E. J. Outen.

KILLED ON ACTIVE SERVICE.—Sgt. G. V. Brooks; Flt. Sgt. A. C. Feisst; Sgt. R. H. Fitchett; Flt. Sgt. J. Henry.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. L. J. Montgomerie.

Indian Air Force

KILLED ON ACTIVE SERVICE.—Cdt. Offier. W. M. Awan.